PCAS 17 (2014/2015)

Supervised Project Report
(ANTA604)

Wildlife Colonies in the Ross Sea

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Student ID: 87412452

Word count: 16,415

Abstract/executive summary:

The Ross Sea region has a very unique assemblage of wildlife colonies, distributed throughout the region. They range from tiny algae and cyanobacteria in meltwater ponds in the McMurdo Dry Valleys to thousands of penguins at Cape Adare. This is a comprehensive report and map of the present wildlife colonies in the Ross Sea region. An extensive literature review was undertaken and the locations of research conducted on algae, cyanobacteria, fungi, lichen, bryophyte (mosses/liverworts), bacteria, protozoa, rotifer, tardigrade, nematode, mites, springtails, sea bird (including penguins), and seal colonies were collated and plotted on a GIS map. The Ross Sea region was defined as the area between 60-90^{o}S and 150-180^{o}E (Waterhouse, 2001). A wildlife colony was defined as a group of organisms of the same species that live and interact with each other in a certain place. This report, together with the GIS map will provide a valuable resource for environmental impact assessment reports, informing field teams and tourism companies and raising awareness about enviromental issues; which can be continually updated.

Wildlife Colonies of the Ross Sea Region

PCAS 2014-15 Supervised Project
Emma Kelman

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INTRODUCTION

The Ross Sea region is unique as it contains the largest area of ice-free land of the whole Antarctic continent. This makes it extremely important habitat for the diverse species of Antarctica. However, very little is known about these species and as yet, a comprehensive map of the present wildlife colonies has not been completed. Building on the work in the Ross Sea region state of the enviroment report by Waterhouse (2001), an extensive literature review was undertaken and the locations of research conducted on algae, cyanobacteria, fungi, lichen, bryophyte (mosses/liverworts), bacteria, protozoa, rotifer, tardigrade, nematode, mites, springtails, sea bird (including penguins), and seal colonies were collated. Then, a GIS map was created with the locations of each colony plotted within the Ross Sea region (Figure 1). The Ross Sea region was defined as the area between 60-90^{o}S and 150-180^{o}E (Waterhouse, 2001). A wildlife colony was defined as a group of organisms of the same species that live and interact with each other in a certain place.

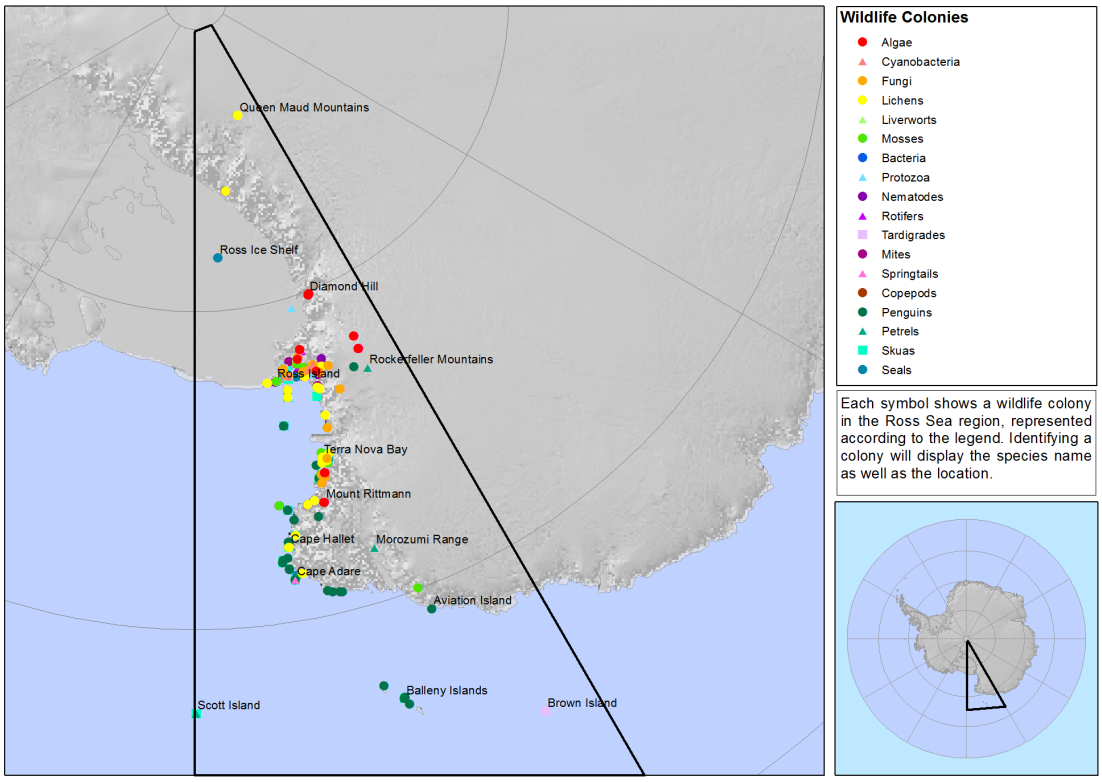

Figure 1. Map of the Ross Sea region

ALGAE & CYANOBACTERIA

Algae and cyanobacteria are the major primary producers in the terrestrial ecosystems of Antarctica and play an important role in the food chain (Waterhouse, 2001). They are found in all moss dominated environments and wherever there is fresh water in the terrestrial enviroment (Waterhouse, 2001). Algae and cyanobacterial mats dominate the ecosystems in lakes, ponds and streams of Antarctica as they are highly adapted to the extreme conditions (Jungblut, Allen, Burns, & Neilan, 2009). 34 species of algae (Table 1) (Figure 2) and 39 species of algae (Table 2) (Figure 3) were found in this study.

Table 1. Locations of algae colonies in the Ross Sea region

Location	Species	Year	Reference
Darwin Glacier (79° 53' 00" S 159° 00' 00" E)	*Phormidium autumnale*	1994	(Warwick F. Vincent & Howard-Williams, 1994)
	Phormidium fragile	1994	(Warwick F. Vincent & Howard-Williams, 1994)
	Schizothrix	1994	(Warwick F. Vincent & Howard-Williams, 1994)
Diamond Hill (79° 52' 00" S 159° 09' 00" E)	*Trebouxia aggregata*	2014	(Colesie, Gommeaux, Green, & Büdel, 2014)
	Acarospora gwynnii	2014	(Claudia Colesie et al., 2014)
	Diplosphaera genus	2014	(Claudia Colesie et al., 2014)
	Heterococcus genus	2014	(Claudia Colesie et al., 2014)
	Trebouxia genus	2014	(Claudia Colesie et al., 2014)
Pyramid Trough (78° 18' 00" S 163° 27' 00" E)	*Coccoid chlorophytes*	1994	(Warwick F. Vincent & Howard-Williams, 1994)
	Schizothrix	1994	(Warwick F. Vincent & Howard-Williams, 1994)
Washington Ridge (78° 06' 00" S 154° 48' 00" W)	*Dictyochlopsis sp*	1996	(W. F. Vincent & James, 1996)
	Stichococcus bacillaris	1996	(W. F. Vincent & James, 1996)
Garwood Valley (78° 02' 00" S 164° 10' 00" E)	*Nostoc commune*	2014	(Claudia Colesie et al., 2014)
McMurdo Dry Valleys (77° 30' 00" S 162° 00' 00" E)	*Hemichloris antarctica*	2014	(De Los Rios, Wierzchos, & Ascaso, 2014)
Edward VII Peninsula	*Chioreiia sp.*	1989	(Paul A. Broady, 1989b)
	Chlorococcum sp.	1989	(Paul A. Broady, 1989b)

(77° 40' 00" S 155° 00' 00" W)	*Coenocystis sp.*	1989	(Paul A. Broady, 1989b)
	Dicfyochloropsis sp.	1989	(Paul A. Broady, 1989b)
	Pseudococcomyxa simplex	1989	(Paul A. Broady, 1989b)
	Lichen gonidia with unicells	1989	(Paul A. Broady, 1989b)
	Stichococcus baciilari	1989	(Paul A. Broady, 1989b)
	Desmococcus vulgaris	1989	(Paul A. Broady, 1989b)
	Prasioia caiophyila	1989	(Paul A. Broady, 1989b)
	Prasiola crispa	1989	(Paul A. Broady, 1989b)
	Prasioia uniseriate filaments	1989	(Paul A. Broady, 1989b)
	Prasiococcus caicarius	1989	(Paul A. Broady, 1989b)
Mount Melbourne (74° 21' 00" S 164° 42' 00" E)	*Chlorella emerszonii*	1987	(P. Broady, Given, Greenfield, & Thompson, 1987)
	Chlorella cf. reniformis	1987	(P. Broady et al., 1987)
	Coccomyxa gloeobotrydiformis	1987	(P. Broady et al., 1987)
	Coenocystis oleifera	1987	(P. Broady et al., 1987)
	Pseudococcomyxa simplex	1987	(P. Broady et al., 1987)
Mount Rittmann (73° 28' 00" E 165° 37' 00" E)	*Phormidiun fragile*	1996	(Bargagli, Broady, & Walton, 1996)
	Lyngbya	1996	(Bargagli et al., 1996)
	Nostoc sp.	1996	(Bargagli et al., 1996)
	Mastigocladus laminosus	1996	(Bargagli et al., 1996)
	Chlorella cf. protothecoides	1996	(Bargagli et al., 1996)
	Chlorella cf. reniformis	1996	(Bargagli et al., 1996)
	Coccomyxa cf. gloeobotrydiformis	1996	(Bargagli et al., 1996)
	Coenocystb cf. oleifera	1996	(Bargagli et al., 1996)
	Oocysfis minufa Guillard	1996	(Bargagli et al., 1996)
	Pseudococcomyxa cf. simplex	1996	(Bargagli et al., 1996)
	Scotiellopsis cf. terrestris	1996	(Bargagli et al., 1996)

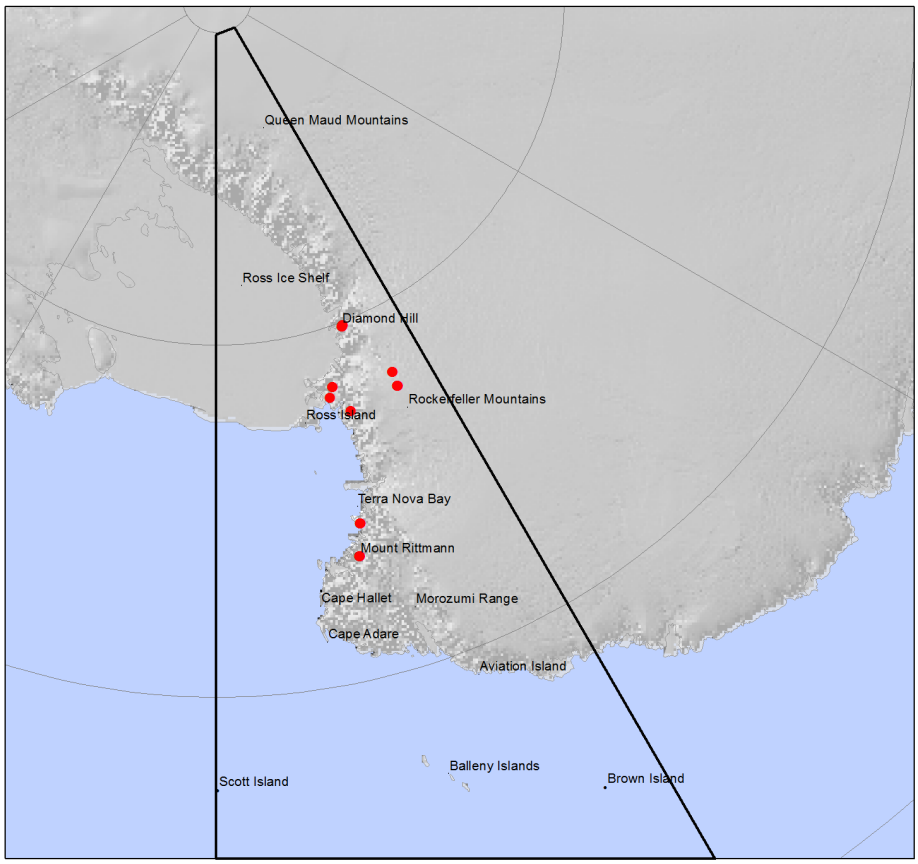

Figure 2. Map of algae colonies in the Ross Sea region

Table 2. Locations of cyanobacteria colonies in the Ross Sea region

Location	Species	Year	Reference
Pyramid Trough (78° 18' 00" S 163° 27' 00" E)	*Calothrix sp*	1994	(Warwick F. Vincent & Howard-Williams, 1994)
	Nostoc genus	1994 2002	(Warwick F Vincent, 2002; Warwick F. Vincent & Howard-Williams, 1994)
	Chroococcus genus	1994 2002	(Warwick F Vincent, 2002; Warwick F. Vincent & Howard-Williams, 1994)
	Gloeocapsa genus	1994 2002	(Warwick F Vincent, 2002; Warwick F. Vincent & Howard-Williams, 1994)
Alph River (78° 12' 00" S 163° 45' 00" E)	*Gloeocapsa genus*	2002	(Warwick F Vincent, 2002)
	Schizothrix	2002	(Warwick F Vincent, 2002)
	Calothrix	2002	(Warwick F Vincent, 2002)
Miers Valley (78° 06' 00" S 164° 00' 00" E)	*Oscillatoriales genus*	2011	(Khan et al., 2011)
	Nostocales genus	2011	(Khan et al., 2011)
Washington Ridge (78° 06' 00" S	*Homeothrix cf. rivularisidge*	1996	(W. F. Vincent & James, 1996)

154° 48' 00" W)			
Garwood Valley (78° 02' 00" S 164° 10' 00" E)	*Oscillatoriales genus*	1991	(Paul A. Broady & Kibblewhite, 1991)
Lake Bonney (77° 44' 00" S 162° 10' 00" E)	*Chamaesiphon genus*	1998	(Priscu et al., 1998)
	Nostoc genus	1998	(Priscu et al., 1998)
	Leptolyngbya genus	1998	(Priscu et al., 1998)
	Phoridium genus	1998	(Priscu et al., 1998)
Canada Glacier (77° 37' 00" S 162° 59' 00" E)	*Oscillatoriales genus*	1991	(Paul A. Broady & Kibblewhite, 1991)
	Phormidium fridigidum	2002	(Warwick F Vincent, 2002)
	Lyngba martensiana	2002	(Warwick F Vincent, 2002)
	Microcoleus paludosus var. acuminatus	2002	(Warwick F Vincent, 2002)
	Nodulin harveyana	2002	(Warwick F Vincent, 2002)
	Synechococcus aeruginosa	2002	(Warwick F Vincent, 2002)
Cape Royds (77° 35' 00" S 166° 10' 00" E)	*Oscillatoriales genus*	1991	(Paul A. Broady & Kibblewhite, 1991)
Edward VII Peninsula (77° 40' 00" S 155° 00' 00" W)	*Aphanocapsa eiachista*	1989	(Paul A. Broady, 1989b)
	Chroococcus minor	1989	(Paul A. Broady, 1989b)
	Chroococcus turgidus	1989	(Paul A. Broady, 1989b)
	Cyanothece aeruginosa	1989	(Paul A. Broady, 1989b)
	Gloeocapsa aipina	1989	(Paul A. Broady, 1989b)
	Gioeocapsa kuetzingiana	1989	(Paul A. Broady, 1989b)
	Gioeocapsa cf. punctata	1989	(Paul A. Broady, 1989b)
	Gloeocapsa ralfsiana	1989	(Paul A. Broady, 1989b)
	Chroococcidiopsis sp.	1989	(Paul A. Broady, 1989b)
	Crinalium cf. magnum	1989	(Paul A. Broady, 1989b)
	Oscillatoriaceae trichomes	1989	(Paul A. Broady, 1989b)
	Phormidium autumnale	1989	(Paul A. Broady, 1989b)
	Phormldium cf.fragiie	1989	(Paul A. Broady, 1989b)
	Phormidium cf. laminosum	1989	(Paul A. Broady, 1989b)
	Schizothrir cf. antarctica	1989	(Paul A. Broady, 1989b)
	Calothrir cf. parietina	1989	(Paul A. Broady, 1989b)
	Homoeothrix cf. rivularis	1989	(Paul A. Broady, 1989b)
	Nostoc sp.	1989	(Paul A. Broady, 1989b)
	Toiypothrix cf. bouteiilei	1989	(Paul A. Broady, 1989b)
	Stigonema minutum	1989	(Paul A. Broady, 1989b)
Mount Melbourne (74° 21' 00" S 164° 42' 00" E)	*Aphanocapsa elachista*	1987	(P. Broady et al., 1987)
	Gloeocapsa magma	1987	(P. Broady et al., 1987)
	Phormidium fragile	1987	(P. Broady et al., 1987)
	Tolypothrix bouteillei	1987	(P. Broady et al., 1987)
	Mastigocladus laminosus	1987	(P. Broady et al., 1987)
	Stigonema ocellatum	1987	(P. Broady et al., 1987)

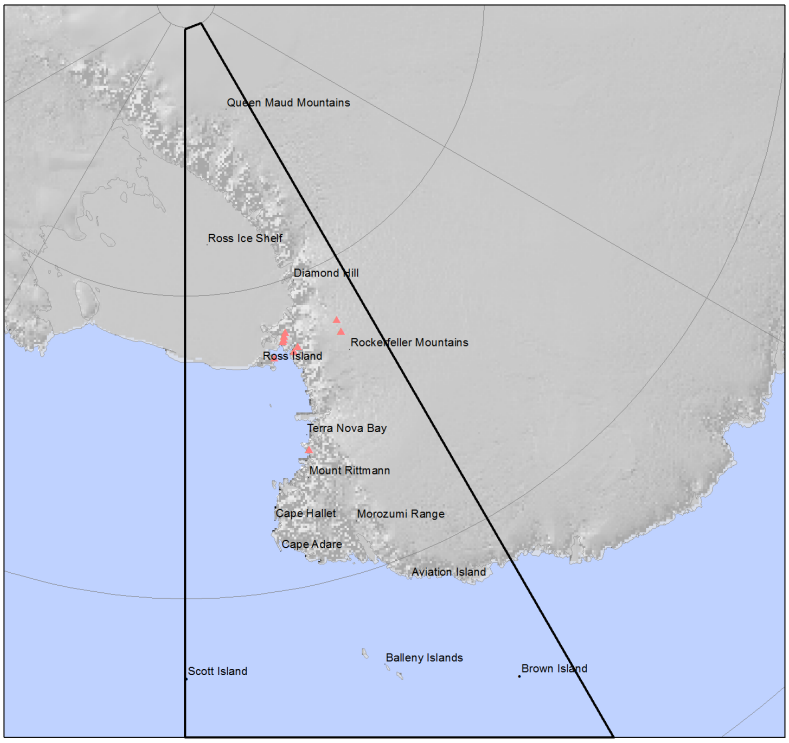

Figure 3. Map of cyanobacteria colonies in the Ross Sea region

FUNGI

Fungi are widely dispersed but in low abundance in the Antarctic (Connell, Redman, Craig, & Rodriguez, 2006). In the most extreme and isolated areas of the continent, such as the McMurdo Dry Valleys, endemic species of fungi showing physiological and morphological adaptations have locally evolved. Most Antarctic fungi, as well as fungi from other dry and cold habitats, are adapted to low temperatures, repeated freeze and thawing cycles, low water availability, osmotic stress, desiccation, low nutrient availability and high UV radiation (Ruisi, Barreca, Selbmann, Zucconi, & Onofri, 2007). Early exploration of Antarctica has also left a legacy of foreign objects that provided vectors for exotic species of fungi to be introduced (Arenz, Held, Jurgens, Farrell, & Blanchette, 2006). This study found 47 species of fungi (Table 3) (Figure 4).

Table 3. Locations of fungi colonies in the Ross Sea region

Location	**Species**	**Year**	**Reference**
Miers Valley (78° 06' 00" S 164° 00' 00" E)	*Ascomycota genus*	2011	(Khan et al., 2011)
	Acremonium genus	2013	(Gokul, Valverde, Tuffin, Cary, & Cowan, 2013)
	Stromatonectria genus	2013	(Gokul et al., 2013)
	Verrucaria genus	2013	(Gokul et al., 2013)
Hut Point (77° 51' 00" S 166° 38' 00" E)	*Antarctomyces psychrotrophicus*	2010	(Duncan, Farrell, Jordan, Jurgens, & Blanchette, 2010)
	Pseudeurotium desertorum	2010	(Duncan et al., 2010)
	Cladosporium cladosporioides	2010 2011	(Arenz, Held, Jurgens, & Blanchette, 2011; Duncan et al., 2010)
	Geomyces pannorum	2010 2011	(Arenz et al., 2011; Duncan et al., 2010)
	Cadophora genus	2011	(Arenz et al., 2011; Farrell et al., 2011)
	Penicillium genus	2011	(Arenz et al., 2011)
Taylor Valley (77° 44' 00" S 162° 10' 00" E)	*Geomycetes sp.*	2006	(Connell et al., 2006)
	Chaunopycnis sp.	2006	(Connell et al., 2006)
	Nematoctonus sp.	2006	(Connell et al., 2006)
	Phaeosphaeria sp.	2006	(Connell et al., 2006)
	Phoma sp.	2006	(Connell et al., 2006)
	Thelebolus microsporus	2006	(Connell et al., 2006)

	Thelebolus sp.	2006	(Connell et al., 2006)
	Rhodotorula mucilaginosa	2006	(Connell et al., 2006)
	Dioszegia sp. 1	2006	(Connell et al., 2006)
	Dioszegia sp 2	2006	(Connell et al., 2006)
	Rhodosporidium kratochvilovae	2006	(Connell et al., 2006)
	Leucosporidium sp.	2006	(Connell et al., 2006)
	Cryptococcus nyarrowii	2006	(Connell et al., 2006)
	Cryptococcus saitoi	2006	(Connell et al., 2006)
	Geomycetes sp.	2006	(Connell et al., 2006)
Cape Evans (77° 38' 00" S 166° 24' 00" E)	*Cadophora malorum*	2004 2011	(Blanchette et al., 2004; Farrell et al., 2011)
	Cadophora luteo-olivacea	2004 2011	(Blanchette et al., 2004; Farrell et al., 2011)
	Pseudeurotium desertorum	2010	(Duncan et al., 2010)
	Cladosporium cladosporioides	2010 2011	(Arenz et al., 2011; Duncan et al., 2010; Farrell et al., 2011)
	Geomyces pannorum	2011	(Arenz et al., 2011; Farrell et al., 2011)
	Penicillium echinulatum	2011	(Arenz et al., 2011; Farrell et al., 2011)
	Penicillium expansum	2011	(Farrell et al., 2011)
	Penicillium roquefortii	2011	(Farrell et al., 2011)
	Cadophora fastigiata	2011	(Farrell et al., 2011)
	Hormonema dematioides	2011	(Farrell et al., 2011)
Lake Fryxell (77° 37' 00" S 163° 11' 00" E)	*Cadophora malorum,*	2011	(Farrell et al., 2011)
	Cadophora luteo- olivacea	2011	(Farrell et al., 2011)
	Cadophora cladosporioides	2011	(Farrell et al., 2011)
	Geomyces genus	2011	(Farrell et al., 2011)
New Harbour (77° 36' 00" S 163° 51' 00" E)	*Cladosporium cladosporioides*	2006 2011	(Farrell et al., 2011; Held, Jurgens, Duncan, Farrell, & Blanchette, 2006)
	Hormonema dematoides	2006 2011	(Farrell et al., 2011; Held et al., 2006)
	Penicillium mali	2006 2011	(Farrell et al., 2011; Held et al., 2006)
	Cadophora malorum	2006	(Held et al., 2006)
	Cadophora luteo-olivacea	2006	(Held et al., 2006)
	Cadophora fastigiata	2004 2006	(Blanchette et al., 2004; Held et al., 2006)
	Lecythophora hoffmani	2006	(Held et al., 2006)
Cape Royds (77° 35' 00" S 166° 10' 00" E)	*Cadophora malorum*	2004	(Blanchette et al., 2004)
	Geomyces pannorum	2011	(Arenz et al., 2011)

Mount Fleming (77° 33' 00" S 160° 06' 00" E)	*Cadophora malorum*	2011	(Farrell et al., 2011)
	Cadophora luteo- olivacea	2011	(Farrell et al., 2011)
	Cadophora cladosporioides	2011	(Farrell et al., 2011)
	Geomyces genus	2011	(Farrell et al., 2011)
McKelvey Valley (77° 26' 00" S 161° 33' 00" E)	*Cryptococcus antarcticus*	2011	(Farrell et al., 2011)
	Cadophora friedmannii	2011	(Farrell et al., 2011)
	Cadophora vishniacii	2011	(Farrell et al., 2011)
	Candida parapsilosis,	2011	(Farrell et al., 2011)
Allan Hill (76° 43' 00" S 159° 40' 00" E)	*Cadophora malorum,*	2011	(Farrell et al., 2011)
	Cadophora luteo- olivacea	2011	(Farrell et al., 2011)
	Cadophora cladosporioides	2011	(Farrell et al., 2011)
	Geomyces genus	2011	(Farrell et al., 2011)
Prior Island (75° 41' 00" S 162° 52' 00" E)	*Geomyces pannorum*	1993	(Mercantini, Marsella, Moretto, & Finotti, 1993)
	Geomyces vinaceus	1993	(Mercantini et al., 1993)
	Cladosporium sp.	1993	(Mercantini et al., 1993)
	Fusarium sp.	1993	(Mercantini et al., 1993)
	Micelia sterilia	1993	(Mercantini et al., 1993)
Adelie Cove (74° 46' 00" S 164° 01' 00" E)	*Geomyces pannorum*	1993	(Mercantini et al., 1993)
Mount Melbourne (74° 21' 00" S 164° 42' 00" E)	*Dematiaceae family*	1993	(Mercantini et al., 1993)
Edmonson Point (74° 20' 00" S 165° 08' 00" E)	*Aspergillus spp.*	1993	(Mercantini et al., 1993)
	Fusarium sp.	1993	(Mercantini et al., 1993)
	Penicillin spp.	1993	(Mercantini et al., 1993)
	Dematiaceae family	1993	(Mercantini et al., 1993)
	Micelia sterilia	1993	(Mercantini et al., 1993)
Baker Rocks (74° 14' 00" S 164° 45' 00" E)	*Geomyces pannorum*	1993	(Mercantini et al., 1993)
	Geomyces vinaceus	1993	(Mercantini et al., 1993)
Kay Island (74° 04' 00" S 165° 19' 00" E)	*Geomyces pannorum*	1993	(Mercantini et al., 1993)
	Geomyces vinaceus	1993	(Mercantini et al., 1993)
	Fusarium sp.	1993	(Mercantini et al., 1993)
	Penicillin spp.	1993	(Mercantini et al., 1993)
	Dematiaceae family	1993	(Mercantini et al., 1993)
	Micelia sterilia	1993	(Mercantini et al., 1993)

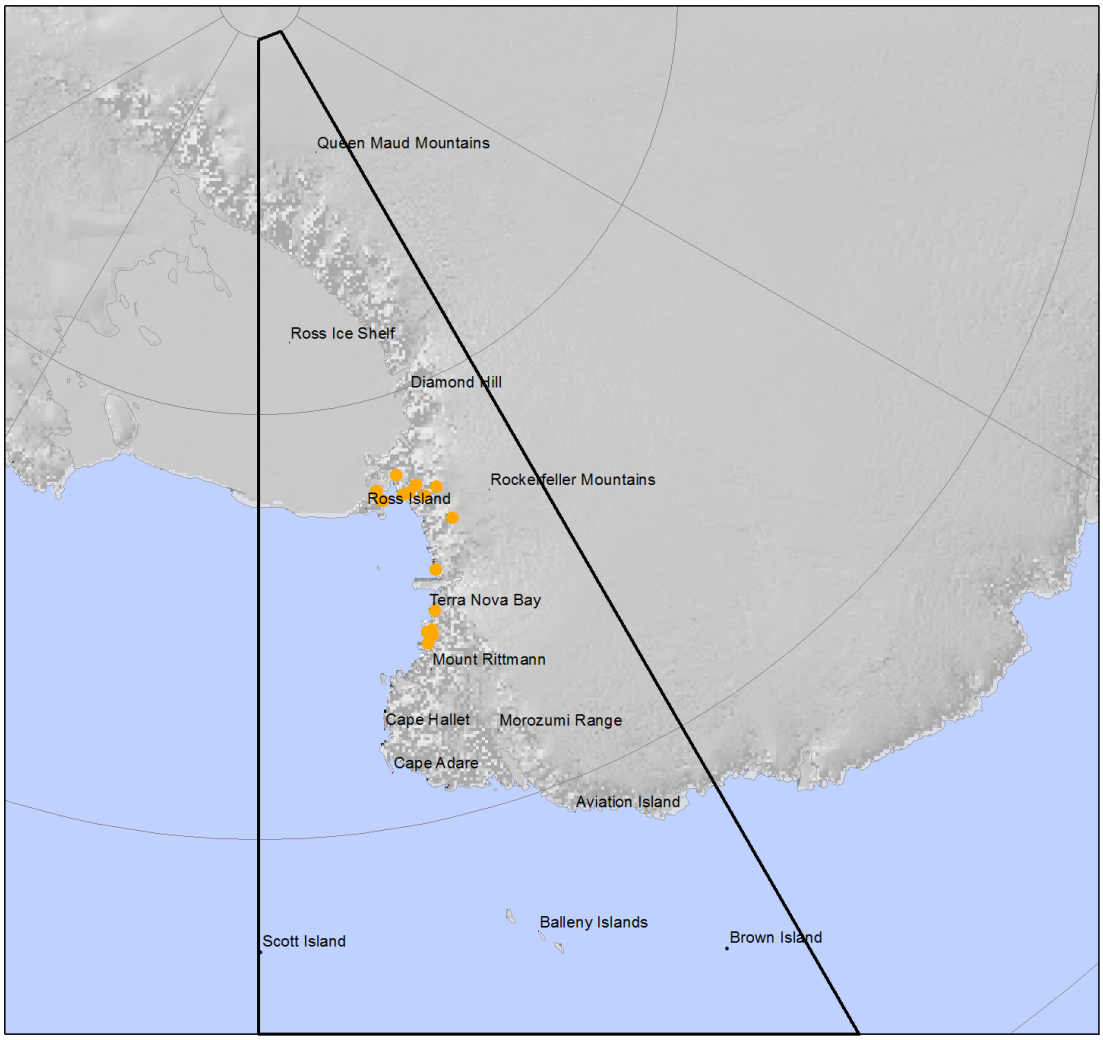

Figure 4. Map of fungi colonies in the Ross Sea region

LICHENS

Lichens are a vital component of terrestrial ecosystems and dominate where other plants reach their physiological limits (Jones, Hogg, Wilkins, & Green, 2013). They are a symbiosis between heterotrophic, fungal (mycobiont) and photosynthetic algal or cyanobacterial (photobiont) components (Jones et al., 2013). Some lichens in Antarctica withstand extreme environmental conditions and live on the surface of rocks whilst others avoid these conditions by colonizing the inside of lithic substrates (Asunción De Los RÍOs, Wierzchos, Sancho, Green, & Ascaso, 2005). The first study of lichens in Victoria Land was made at the end of 19th century during Borchgrevink's expeditions (Smykla, Krzewicka, Wilk, Emslie, & Śliwa, 2011). Studies on lichen vegetation in Antarctica are particularly difficult due to their complicated taxonomy which is an obstacle to the accurate identification of many samples at species level (Castello & Nimis, 2000). There are approximately 135 lichen species in the Ross Sea region (Table 4) (Figure 5).

Table 4. Locations of lichen colonies in the Ross Sea region

Location	**Species**	**Year**	**Reference**
Queen Maud Mountains (86° 00' 00" S 160° 00' 00" W)	*Acarospora gwynnii*	2014	(C. Colesie et al., 2014)
	Acarospora williamsii	2014	(C. Colesie et al., 2014)
	Buellia frigida	2014	(C. Colesie et al., 2014)
	Buellia latemarginata	2014	(C. Colesie et al., 2014)
	Buellia lignoides	2014	(C. Colesie et al., 2014)
	Caloplaca athallina	2014	(C. Colesie et al., 2014)
	Caloplaca darbishirei	2014	(C. Colesie et al., 2014)
	Candelariella flava	2014	(C. Colesie et al., 2014)
	Carbonea vitellinaria	2014	(C. Colesie et al., 2014)
	Hymenelia glacialis	2014	(C. Colesie et al., 2014)
	Lecanora expectans	2014	(C. Colesie et al., 2014)
	Lecanora physciella	2014	(C. Colesie et al., 2014)
	Lecanora polytropa	2014	(C. Colesie et al., 2014)
	Lecidea andersonii	2014	(C. Colesie et al., 2014)
	Lecidea cancriformis	2014	(C. Colesie et al., 2014)
	Lecidella greenii	2014	(C. Colesie et al., 2014)
	Lecidella siplei	2014	(C. Colesie et al., 2014)
	Lepraria aff. cacuminum	2014	(C. Colesie et al., 2014)
	Micarea cf. turfosa	2014	(C. Colesie et al., 2014)
	Physcia caesia	2014	(C. Colesie et al., 2014)

	Pleopsidium chlorophanum	2014	(C. Colesie et al., 2014)
	Polysporina frigida	2014	(C. Colesie et al., 2014)
	Pseudephebe minuscula	2014	(C. Colesie et al., 2014)
	Pseudephebe pubescens	2014	(C. Colesie et al., 2014)
	Psoroma hypnorum	2014	(C. Colesie et al., 2014)
	Rhizocarpon adarense	2014	(C. Colesie et al., 2014)
	Rhizocarpon geographicum	2014	(C. Colesie et al., 2014)
	Rhizocarpon nidificum	2014	(C. Colesie et al., 2014)
	Rhizocarpon superficiale	2014	(C. Colesie et al., 2014)
	Rhizoplaca melanophthalma	2014	(C. Colesie et al., 2014)
	Sarcogyne privigna	2014	(C. Colesie et al., 2014)
	Umbilicaria aprina	2014	(C. Colesie et al., 2014)
	Umbilicaria decussata	2014	(C. Colesie et al., 2014)
	Xanthomendoza borealis	2014	(C. Colesie et al., 2014)
Beardmore Glacier (83° 45' 00" S 171° 00' 00" E)	*Buellia frigida*	2013	(Jones et al., 2013)
Diamond Hill (79° 52' 00" S 159° 09' 00" E)	*Acarospora gwynnii*	2014	(C. Colesie et al., 2014)
	Buellia frigida	2014	(C. Colesie et al., 2014)
	Carbonea vorticosa	2014	(C. Colesie et al., 2014)
	Lecanora expectans	2014	(C. Colesie et al., 2014)
	Lecidea cancriformis	2014	(C. Colesie et al., 2014)
	Lecidella greenii	2014	(C. Colesie et al., 2014)
	Lecidella patavina	2014	(C. Colesie et al., 2014)
	Pleopsidium chlorophanum	2014	(C. Colesie et al., 2014)
	Rhizoplaca melanophthalma	2014	(C. Colesie et al., 2014)
Taylor Valley (77° 37' 00" S 163° 00' 00" E)	*Buellia frigida*	2007 2012 2014	(Allan Green, Brabyn, Beard, & Sancho, 2012; C. Colesie et al., 2014; Sancho, Allan Green, & Pintado, 2007)
	Acarospora gwynnii	2014	(C. Colesie et al., 2014)
	Buellia frigida	2014	(C. Colesie et al., 2014)
	Caloplaca darbishirei	2014	(C. Colesie et al., 2014)
	Carbonea vorticosa	2014	(C. Colesie et al., 2014)
	Lecanora expectans	2014	(C. Colesie et al., 2014)
	Lecanora polytropa	2014	(C. Colesie et al., 2014)
	Lecidea andersonii	2014	(C. Colesie et al., 2014)
	Lecidea cancriformis	2014	(C. Colesie et al., 2014)
	Lecidella greenii	2014	(C. Colesie et al., 2014)
	Lecidella siplei	2014	(C. Colesie et al., 2014)
	Lecidella stigmatea	2014	(C. Colesie et al., 2014)

	Lecidella patavina	2014	(C. Colesie et al., 2014)
	Polysporina frigida	2014	(C. Colesie et al., 2014)
	Sarcogyne privigna	2014	(C. Colesie et al., 2014)
	Umbilicaria aprina	2013 2014	(C. Colesie et al., 2014; Jones et al., 2013)
	Verrucaria otagensis	2014	(C. Colesie et al., 2014)
	Xanthoria elegans	2014	(C. Colesie et al., 2014)
Linnaeus Terrace (77° 36' 00" S 161° 05' 00" E)	*Buellia pallida*	1987	(Hale, 1987)
	Buellia grisea	1987	(Hale, 1987)
	Acarospora gwynnii	1987	(Hale, 1987)
	Lecanora fuscobrunnea	1987	(Hale, 1987)
	Lecidea siplei	1987	(Hale, 1987)
	Carbonea capsulate	1987	(Hale, 1987)
	Lecidea cancriformis	1987	(Hale, 1987)
Cape Royds (77° 35' 00" S 166° 10' 00" E)	*Usnea antarctica*	1989	(Paul A. Broady, 1989a)
	Umbilicaria aprina	1989	(Paul A. Broady, 1989a)
Cape Crozier (77° 31' 00" S 169° 24' 00" E)	*Usnea antarctica*	1989	(Paul A. Broady, 1989a)
	Umbilicaria aprina	1989	(Paul A. Broady, 1989a)
	Buellia pallida	2011	(Smykla et al., 2011)
	Buellia darbishirei	2011	(Smykla et al., 2011)
	Caloplaca citrina	2011	(Smykla et al., 2011)
	Caloplaca erecta	2011	(Smykla et al., 2011)
	Caloplaca saxicola	2011	(Smykla et al., 2011)
	Caloplaca schofieldi	2011	(Smykla et al., 2011)
	Caloplaca soropelta	2011	(Smykla et al., 2011)
	Lecania nylanderiana	2011	(Smykla et al., 2011)
	Lecanora expectans	2011	(Smykla et al., 2011)
	Lecanora mons–nivis	2011	(Smykla et al., 2011)
	Lecidella siplei	2011	(Smykla et al., 2011)
	Physcia dubia	2011	(Smykla et al., 2011)
	Rhizoplaca melanophthalma	2011	(Smykla et al., 2011)
	Rinodina sp. 1	2011	(Smykla et al., 2011)
Marble Point (77° 26' 00" S 163° 50' 00" E)	*Caloplaca tominii*	2011	(Smykla et al., 2011)
	Lecanora expectans	2011	(Smykla et al., 2011)
Cape Bird (77° 10' 00" S 166° 41' 00" E)	*Caloplaca darbishirei*	1989	(Paul A. Broady, 1989a)
Botany Bay (77° 00' 00" S 162° 35' 00" E)	*Xanthoria elegans*	2003	(Sancho & Schroeter, 2003)
	Physcia dubia	2003	(Sancho & Schroeter, 2003)
	Xanthoria mawsonii	2003 2006	(Pannewitz et al., 2006; Sancho & Schroeter, 2003)
	Caloplaca antarct	2010	(Rodney D. Seppelt et al.,

			2010)
	Rhizocarpon geographicum	2010	(Rodney D. Seppelt et al., 2010)
	Rhizoplaca cf. priestleyi	2010	(Rodney D. Seppelt et al., 2010)
	Acarospora gwynnii	2010	(Rodney D. Seppelt et al., 2010)
	Acarospora gwynnii	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Amandinea petermannii	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Buellia frigida	2010 2013 2014	(C. Colesie et al., 2014; Jones et al., 2013; Rodney D. Seppelt et al., 2010)
	Buellia cf. papillata	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Buellia subfrigida	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Caloplaca athallina	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Caloplaca coeruleofrigida	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Caloplaca cf. schofieldii	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Caloplaca saxicola	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Candelariella flava	2003 2010 2014	(C. Colesie et al., 2014; Sancho & Schroeter, 2003; Rodney D. Seppelt et al., 2010)
	Carbonea vorticosa	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Lecanora expectans	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Lecanora mons-nivis	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Lecidea andersonii	2010	(C. Colesie et al., 2014;

		2014	Rodney D. Seppelt et al., 2010)
	Lecidea cancriformis	2005 2010 2014	(C. Colesie et al., 2014; Sancho & Schroeter, 2003; Rodney D. Seppelt et al., 2010)
	Lecidella siplei	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Leproloma cacuminum	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Physcia caesia	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Physcia dubia	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Rhizocarpon geminatum	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Rhizoplaca melanophthalma	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Sarcogyne privigna	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Turgidosculum complicatulum	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Xanthoria elegans	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Xanthomendoza borealis	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Umbilicaria aprina	2005 2010 2011 2013 2014	(C. Colesie et al., 2014; A. De los Ríos, Sancho, Grube, Wierzchos, & Ascaso, 2005; Jones et al., 2013; Burkhard Schroeter, Green, Pannewitz, Schlensog, & Sancho, 2010, 2011; Rodney D. Seppelt et al., 2010)
	Caloplaca darbishirei	2006 2014	(C. Colesie et al., 2014; Søchting & Castello, 2012)
	Tephromela priestleyi	2014	(C. Colesie et al., 2014)
Beaufort Island	*Caloplaca citrina*	2011	(Smykla et al., 2011)

(76° 56' 00" S 166° 56' 00" E)	*Caloplaca saxicola*	2011	(Smykla et al., 2011)
	Caloplaca tominii	2011	(Smykla et al., 2011)
	Xanthoria candelaria	2011	(Smykla et al., 2011)
Kar Plateau (76° 56' 00" S 162° 20' 00" E)	*Acarospora gwynnii*	1999	(R. Seppelt, Green, & Schroeter, 1995; Rodney D Seppelt, Green, & Skotnicki, 1999)
	Aspicilia glacialis	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Buellia frigida	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Caloplaca athallina	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Caloplaca antarct	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Caloplaca sp. 1	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Caloplaca sp. 2	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Lecania sp.	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Lecanora expectans	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Lecanora fuscobrunnea	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Lecanora griseomarginata	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Lecidea blackburnii	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Lecidea cancriformis	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Lecidella siplei	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Lecidea sp.	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al.,

			1999)
	Physcia caesia	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Rhizocarponflavum	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Rhizocarpon schofieldii	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Rhizoplaca melanophthalma	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Rhizoplaca priestleyi	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Rinodina sp.	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Thelidiola caloplacae	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Umbilicaria aprina	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Usnea antarctica	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Xanthoria elegans	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
Cape Hickey (76° 05' 00" S 162° 38' 00" E)	*Buellia darbishirei*	2011	(Smykla et al., 2011)
	Buellia frigida	2011	(Smykla et al., 2011)
	Caloplaca tominii	2011	(Smykla et al., 2011)
	Candelariella flava	2011	(Smykla et al., 2011)
	Lecanora expectans	2011	(Smykla et al., 2011)
	Lecanora fuscobrunnea	2011	(Smykla et al., 2011)
	Lecidella siplei	2011	(Smykla et al., 2011)
	Physcia caesia	2011	(Smykla et al., 2011)
	Xanthomendoza borealis	2011	(Smykla et al., 2011)
Prior Island (75° 41' 00" S 162° 52' 00" E)	*Buellia frigida*	2011	(Smykla et al., 2011)
	Buellia papillata	2011	(Smykla et al., 2011)
	Caloplaca athallina	2011	(Smykla et al., 2011)
	Caloplaca citrina	2011	(Smykla et al., 2011)
	Caloplaca tominii	2011	(Smykla et al., 2011)
	Candelariella flava	2011	(Smykla et al., 2011)
	Lecanora expectans	2011	(Smykla et al., 2011)
	Lecanora fuscobrunnea	2011	(Smykla et al., 2011)

	Lecidella siplei	2011	(Smykla et al., 2011)
	Lepraria alpina	2011	(Smykla et al., 2011)
	Physcia caesia	2011	(Smykla et al., 2011)
	Physcia dubia	2011	(Smykla et al., 2011)
	Physcia tenella	2011	(Smykla et al., 2011)
	Rinodina olivaceobrunnea	2011	(Smykla et al., 2011)
	Umbilicaria decussata	2011	(Smykla et al., 2011)
	Usnea sphacelata	2011	(Smykla et al., 2011)
	Usnea antarctica	2011	(Smykla et al., 2011)
	Xanthomendoza borealis	2011	(Smykla et al., 2011)
Inexpressible Island (74° 54' 00" S 163° 39' 00" E)	*Caloplaca soropelta*	2006	(Søchting & Castello, 2012)
	Acarospora gwynnii	2011	(Smykla et al., 2011)
	Buellia frigida	2011	(Smykla et al., 2011)
	Buellia pallida	2011	(Smykla et al., 2011)
	Candelariella flava	2011	(Smykla et al., 2011)
	Buellia papillata	2011	(Smykla et al., 2011)
	Caloplaca tominii	2011	(Smykla et al., 2011)
	Lecanora expectans	2011	(Smykla et al., 2011)
	Lecanora fuscobrunnea	2011	(Smykla et al., 2011)
	Xanthomendoza borealis	2011	(Smykla et al., 2011)
Terra Nova Bay (74° 50' 00" S 164° 30' 00" E)	*Buellia frigida*	2013 2014	(C. Colesie et al., 2014; Jones et al., 2013)
	Umbilicaria aprina	2013 2014	(C. Colesie et al., 2014; Jones et al., 2013)
	Umbilicaria decussata	2013 2014	(C. Colesie et al., 2014; Jones et al., 2013)
	Buellia evanescens	2014	(C. Colesie et al., 2014)
	Buellia lignoides	2014	(C. Colesie et al., 2014)
	Buellia papillata	2014	(C. Colesie et al., 2014)
	Buellia pallida	2014	(C. Colesie et al., 2014)
	Caloplaca athallina	2014	(C. Colesie et al., 2014)
	Caloplaca darbishirei	2014	(C. Colesie et al., 2014)
	Candelaria murrayi	2014	(C. Colesie et al., 2014)
	Candelariella flava	2014	(C. Colesie et al., 2014)
	Candelariella vitellina	2014	(C. Colesie et al., 2014)
	Lecanora expectans	2014	(C. Colesie et al., 2014)
	Lecanora flotowiana	2014	(C. Colesie et al., 2014)
	Lecanora mons-nivis	2014	(C. Colesie et al., 2014)
	Lecanora sverdrupiana	2014	(C. Colesie et al., 2014)
	Lecidea andersonii	2014	(C. Colesie et al., 2014)
	Lecidea cancriformis	2014	(C. Colesie et al., 2014)
	Lecidella siplei	2014	(C. Colesie et al., 2014)
	Physcia caesia	2014	(C. Colesie et al., 2014)
	Pleopsidium chlorophanum	2014	(C. Colesie et al., 2014)
	Pseudephebe minuscula	2014	(C. Colesie et al., 2014)

	Rinodina olivaceobrunnea	2014	(C. Colesie et al., 2014)
	Usnea antarctica	2014	(C. Colesie et al., 2014)
	Usnea sphacelata	2014	(C. Colesie et al., 2014)
	Xanthoria elegans	2014	(C. Colesie et al., 2014)
	Acarospora gwynnii	1995	(Castello & Nimis, 2000)
	Acarospora nitrophila	1995	(Castello & Nimis, 2000)
	Amandinea coniops	1995	(Castello & Nimis, 2000)
	Buellia atr darbishirei	1995	(Castello & Nimis, 2000)
	Buellia cf. cladocarpiza	1995	(Castello & Nimis, 2000)
	Caloplaca citritna	1995	(Castello & Nimis, 2000)
	Lecanora fuscobrunnea	1995	(Castello & Nimis, 2000)
	Lecanora physciella	1995	(Castello & Nimis, 2000)
	Rhizocarpon superfciale	1995	(Castello & Nimis, 2000)
	Rhizoplaca melanophthalma	1995	(Castello & Nimis, 2000)
	Tephromela atra	1995	(Castello & Nimis, 2000)
	Umbilicaria decussata	1995	(Castello & Nimis, 2000)
	Umbilicaria decussata	1995	(Castello & Nimis, 2000)
	Xanthoria mawsonii	1995	(Castello & Nimis, 2000)
Adelie Cove (74° 46' 00" S 164° 01' 00" E)	*Acarospora gwynnii*	2011	(Smykla et al., 2011)
	Buellia frigida	2011	(Smykla et al., 2011)
	Buellia lignoides	2011	(Smykla et al., 2011)
	Lecanora polytropa	2011	(Smykla et al., 2011)
	Lecidea cancriformis	2011	(Smykla et al., 2011)
	Pleopsidium chlorophanum	2011	(Smykla et al., 2011)
	Umbilicaria decussata	2011	(Smykla et al., 2011)
North Adelie Cove (74° 44' 00" S 164° 07' 00" E)	*Acarospora gwynnii*	2011	(Smykla et al., 2011)
	Amandinea coniops	2011	(Smykla et al., 2011)
	Buellia frigida	2011	(Smykla et al., 2011)
	Buellia papillata	2011	(Smykla et al., 2011)
	Caloplaca athallina	2011	(Smykla et al., 2011)
	Caloplaca citrina	2011	(Smykla et al., 2011)
	Caloplaca tominii	2011	(Smykla et al., 2011)
	Candelariella flava	2011	(Smykla et al., 2011)
	Lecanora expectans	2011	(Smykla et al., 2011)
	Lecidella siplei	2011	(Smykla et al., 2011)
	Physcia caesia	2011	(Smykla et al., 2011)
	Physcia dubia	2011	(Smykla et al., 2011)
	Pleopsidium chlorophanum	2011	(Smykla et al., 2011)
	Pseudephebe minuscula	2011	(Smykla et al., 2011)
	Rinodina olivaceobrunnea	2011	(Smykla et al., 2011)
	Umbilicaria decussata	2011	(Smykla et al., 2011)
	Usnea antarctica	2011	(Smykla et al., 2011)
	Usnea sphacelata	2011	(Smykla et al., 2011)

	Xanthomendoza borealis	2011	(Smykla et al., 2011)
	Xanthoria elegans	2011	(Smykla et al., 2011)
Icarus Camp (74° 42' 00" S 164° 07' 00" E)	*Acarospora gwynnii*	2011	(Smykla et al., 2011)
	Amandinea coniops	2011	(Smykla et al., 2011)
	Buellia frigida	2011	(Smykla et al., 2011)
	Buellia grimmiae	2011	(Smykla et al., 2011)
	Caloplaca athallina	2011	(Smykla et al., 2011)
	Caloplaca citrina	2011	(Smykla et al., 2011)
	Caloplaca tominii	2011	(Smykla et al., 2011)
	Candelariella flava	2011	(Smykla et al., 2011)
	Lecanora expectans	2011	(Smykla et al., 2011)
	Lecanora fuscobrunnea	2011	(Smykla et al., 2011)
	Lecidella siplei	2011	(Smykla et al., 2011)
	Lepraria alpina	2011	(Smykla et al., 2011)
	Physcia caesia	2011	(Smykla et al., 2011)
	Pseudephebe minuscula	2011	(Smykla et al., 2011)
	Usnea antarctica	2011	(Smykla et al., 2011)
	Xanthomendoza borealis	2011	(Smykla et al., 2011)
	Xanthoria elegans	2011	(Smykla et al., 2011)
Harrow Peaks (74° 40' 00" S 164° 45' 00" E)	*Caloplaca darbishirei*	2006	(Søchting & Castello, 2012)
Edmonson Point (74° 20' 00" S 165° 08' 00" E)	*Acarospora williamsii*	2011	(Smykla et al., 2011)
	Amandinea coniops		(Smykla et al., 2011)
	Buellia darbishirei	2011	(Smykla et al., 2011)
	Buellia pallida	2011	(Smykla et al., 2011)
	Caloplaca citrina	2011	(Smykla et al., 2011)
	Caloplaca saxicola	2011	(Smykla et al., 2011)
	Caloplaca tominii	2011	(Smykla et al., 2011)
	Candelariella flava	2011	(Smykla et al., 2011)
	Lecanora expectans	2011	(Smykla et al., 2011)
	Lecanora fuscobrunnea	2011	(Smykla et al., 2011)
	Lecanora mons–nivis	2011	(Smykla et al., 2011)
	Lepraria alpina	2011	(Smykla et al., 2011)
	Xanthomendoza borealis	2011	(Smykla et al., 2011)
Apostrophe Island (73° 31' 00" S 167° 26' 00" E)	*Caloplaca darbishirei*	2006	(Søchting & Castello, 2012)
Cape King (73° 35' 00" S 166° 37' 00" E)	*Caloplaca darbishirei*	2006	(Søchting & Castello, 2012)
Crater Cirque (72° 38' 00" S 169° 22' 00" E)	*Caloplaca darbishirei*	2006	(Søchting & Castello, 2012)
Cape Hallet (72° 19' 00" S 170° 16' 00" E)	*Xanthoria mawsonii*	2006	(Pannewitz et al., 2006)
	Buellia frigida	2007	(Sancho et al., 2007)
	Amandinea coniops	2011	(Smykla et al., 2011)

	Caloplaca saxicola	2011	(Smykla et al., 2011)
	Candelaria murrayi	2011	(Smykla et al., 2011)
	Lecanora mons–nivis	2011	(Smykla et al., 2011)
	Usnea sphacelata	2015	(Crittenden et al., 2015)
	Umbilicaria decussata	2015	(Crittenden et al., 2015)
	Xanthomendoza borealis	2015	(Crittenden et al., 2015)
Birthday Ridge (71° 26' 00" S 169° 24' 00" E)	*Usnea picata*	1985	(Kappen, 1985)
	Usnea sulphurea	1985	(Kappen, 1985)
	Neuropogon sulfureus	1985	(Kappen, 1985)
	Pseudephebe minuscula	1985	(Kappen, 1985)
	Parmelia minuscula	1985	(Kappen, 1985)
	Alectoria minuscula	1985	(Kappen, 1985)
	Umbilicaria decussata	1985	(Kappen, 1985)
	Omphalodiscus decussatus	1985	(Kappen, 1985)
	Lecidea physciella	1985	(Kappen, 1985)
	Buellia frigida	1985	(Kappen, 1985)
	Physcia caesia	1985	(Kappen, 1985)
	Parmelia coreyi	1985	(Kappen, 1985)
	Rhizocarpon griseolum	1985	(Kappen, 1985)
	Buellia lignoides	1985	(Kappen, 1985)
	Lecidea capsulata	1985	(Kappen, 1985)
	Lecidea endolith.	1985	(Kappen, 1985)
	Lecidella antarctica	1985	(Kappen, 1985)
	Bryum algens	1985	(Kappen, 1985)
	Bryum argenteum	1985	(Kappen, 1985)
	Grimmia lawiana	1985	(Kappen, 1985)
	Ceratodon purpureus	1985	(Kappen, 1985)
	Grimmia antarctici	1985	(Kappen, 1985)
	Caloplaca athallina	1985	(Kappen, 1985)
	Rinodina olivaceobrunnea	1985	(Kappen, 1985)
	Rinodina archaeoides	1985	(Kappen, 1985)
	Lepraria neglecta	1985	(Kappen, 1985)
	Rhizoplaca melanophthalma	1985	(Kappen, 1985)
	Lecanora rubina vat. Melanophthalma	1985	(Kappen, 1985)
	Caloplaca citrina	1985	(Kappen, 1985)
	Pyrenodesmia mawsonii	1985	(Kappen, 1985)
	Candelariella antarctica	1985	(Kappen, 1985)
	Protoblastenia citrina	1985	(Kappen, 1985)
	Catillaria corymbosa	1985	(Kappen, 1985)
	Ochrolechia tartarea v. Frigida	1985	(Kappen, 1985)

	Buellia grimmiae	1985	(Kappen, 1985)
	Rinodina turfacea	1985	(Kappen, 1985)
	Rinodina orbata	1985	(Kappen, 1985)
	Lecanora expectans	1985	(Kappen, 1985)
	Physcia dubia	1985	(Kappen, 1985)
	Xanthoria candelaria v. Antarctica	1985	(Kappen, 1985)
	Xanthoria candelaria	1985	(Kappen, 1985)
	Xanthoria mawsonii	1985	(Kappen, 1985)
	Candelaria spec.	1985	(Kappen, 1985)
	Biatorella antarctica	1985	(Kappen, 1985)
	Biatorella cerebriformis	1985	(Kappen, 1985)
	Buellia cladocarpiza	1985	(Kappen, 1985)
	Caloplaca elegans	1985	(Kappen, 1985)
	Xanthoria elegans	1985	(Kappen, 1985)
	Caloplaca elegans var. Pulvinata	1985	(Kappen, 1985)
	Buellia cf. Punctata	1985	(Kappen, 1985)
	Pseudephebe cf. Pubescens	1985	(Kappen, 1985)
	Parmelia pubescens	1985	(Kappen, 1985)
	Alectoria pubescens	1985	(Kappen, 1985)
	Umbilicaria aprina	1985	(Kappen, 1985)
	Omphalodiscus antarcticus	1985	(Kappen, 1985)
	Usnea picata	1985	(Kappen, 1985)
	Neuropogon acromelanus v. Inactivus	1985	(Kappen, 1985)
	A carospora macrocyclos	1985	(Kappen, 1985)
	Prasiola crispa	1985	(Kappen, 1985)

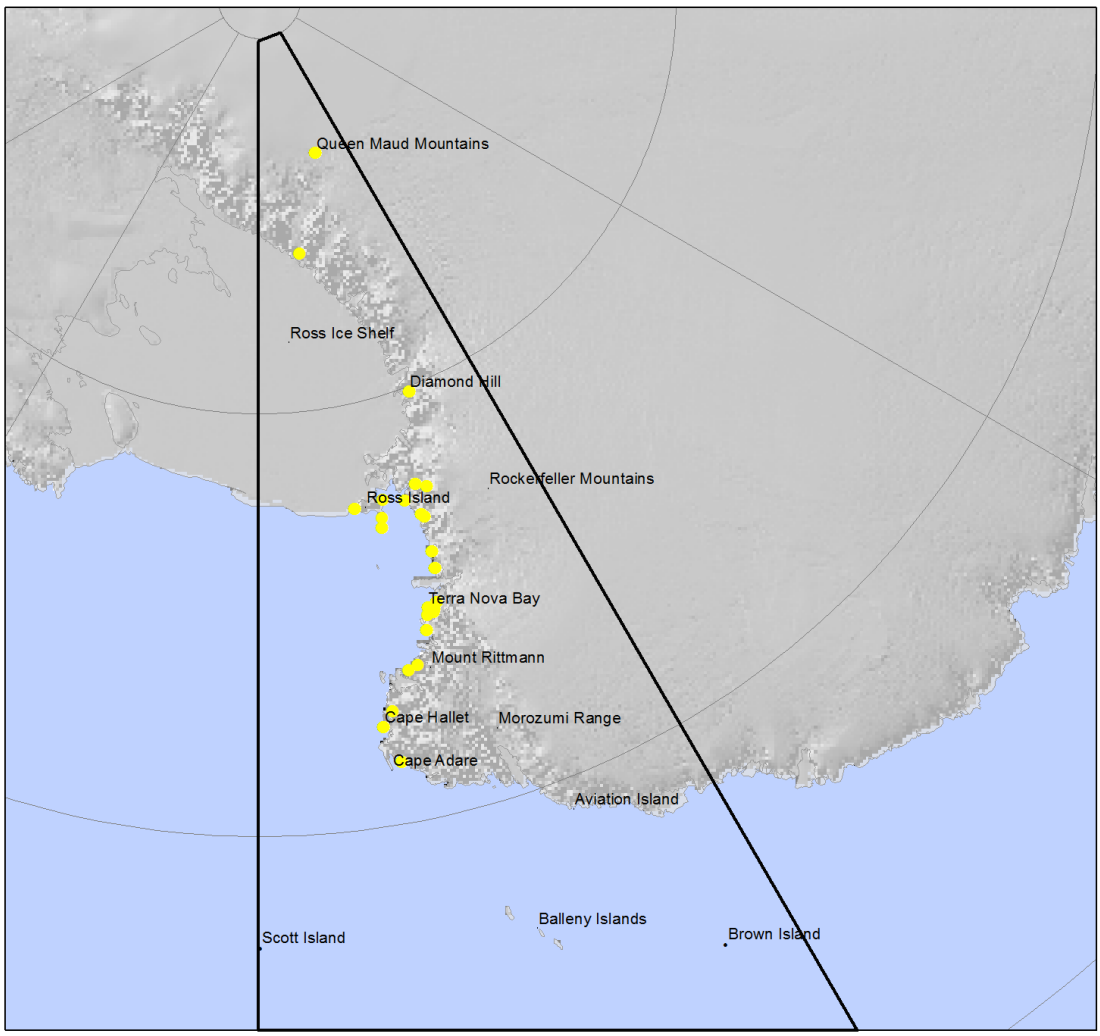

Figure 5. Map of lichen colonies in the Ross Sea region

BRYOPHYTES (MOSSES & LIVERWORTS)

Due to Antarctica's long-term isolation and extreme climatic conditions, terrestrial ecosystems are comprised of very simple communities (Cannone, Convey, & Guglielmin, 2013). Only 2% of the land in Antarctica in is ice-free and available for colonisation by plants (M. Skotnicki, Ninham, & Selkirk, 1999) and therefore vegetation is dominated by simple terrestrial plants such as bryophytes (mosses and liverworts) and lichens (Mary L Skotnicki, Ninham, & Selkirk, 1998). Environmental conditions are harsh, with extreme temperatures, 24-hour daylight, strong winds and low precipitation so they have evolved a poikilohydric lifestyle and grow in clumps in sheltered areas (Pannewitz et al., 2005; M. Skotnicki et al., 1999). Bryum is the most abundant and widespread genus in the continental Antarctic moss flora (R. D. Seppelt & Green, 1998). Liverworts are less abundant and poorly studied in comparison. Terrestrial organisms are potential indicators of the effects of climate change so research into their abundance and distribution is very important (Green, Sancho, Türk, Seppelt, & Hogg, 2011). In this study, 29 species of mosses (Table 5) (Figure 6) and 2 species of liverwort (Table 6) (Figure 7) were found, including the southernmost location for a sporophyte producing moss (*Hennediella heimii*) (Waterhouse, 2001).

Table 5. Locations of moss colonies in the Ross Sea region

Location	Species	Year	Reference
Queen Maud Mountains (86° 00' 00" S 160° 00' 00" W)	*Orthogrimmia sessitana*	2014	(C. Colesie et al., 2014)
	Schistidium antarctici	2014	(C. Colesie et al., 2014)
Diamond Hill (79° 52' 00" S 159° 09' 00" E)	*Bryum argenteum*	2014	(C. Colesie et al., 2014)
Garwood Valley (78° 02' 00" S 164° 10' 00" E)	*Bryum argentuem*	1998	(Mary L Skotnicki et al., 1998)
	Anomobryum subrotundifolium	2007	(M. I. Stevens, Hunger, Hills, & Gemmill, 2007)
	Hennediella heimii	2007	(M. I. Stevens et al., 2007)

Miers Valley (78° 06' 00" S 164° 00' 00" E)	*Anomobryum subrotundifolium*	2007	(M. I. Stevens et al., 2007)
Hobbs Glacier (77° 54' 00" S 164° 24' 00" E)	*Hennediella heimii*	1992 2005	(R. D. Seppelt, Green, Schwarz, & Frost, 1992; M. L. Skotnicki, Mackenzie, Clements, & Selkirk, 2005)
	Bryum argenteum	2005	(M. L. Skotnicki et al., 2005)
Kukri Hills (77° 44' 00" S 162° 42' 00" E)	*Ceratodon purpureus*	1998	(R. D. Seppelt & Green, 1998)
Taylor Valley (77° 44' 00" S 162° 10' 00" E)	*Bryum argenteum*	2014	(C. Colesie et al., 2014)
	Bryum pseudotriquetrum	2014	(C. Colesie et al., 2014)
	Hennediella heimii	2014	(C. Colesie et al., 2014)
	Syntrichia sarconeurum	2014	(C. Colesie et al., 2014)
Canada Glacier (77° 37' 00" S 162° 59' 00" E)	*Hennediella heimii*	1992	(R. D. Seppelt et al., 1992)
	Bryum argenteum	1992 2005	(R. D. Seppelt et al., 1992; M. L. Skotnicki et al., 2005)
	Bryum pseudofriquefrum	1992 1998 2005	(R. D. Seppelt & Green, 1998; R. D. Seppelt et al., 1992; M. L. Skotnicki et al., 2005)
	Sarconeurum glaciale	1999	(Selkirk et al., 1997; M. Skotnicki et al., 1999)
Lake Fryxell (77° 37' 00" S 163° 11' 00" E)	*Bryum argentuem*	1998	(Mary L Skotnicki et al., 1998)
	Bryum pseudotriquetrum	1998	(R. D. Seppelt & Green, 1998)
Cape Royds (77° 35' 00" S 166° 10' 00" E)	*Bryum subrotundifolium*	1998	(R. D. Seppelt & Green, 1998)
	Bryum argenteum	2005	(M. L. Skotnicki et al., 2005)
Cape Crozier (77° 31' 00" S 169° 24' 00" E)	*Sarconeurum glaciale*	1998	(R. D. Seppelt & Green, 1998)
	Bryum subrotundifolium	1998	(R. D. Seppelt & Green, 1998)
Ross Island (77° 30' 00" S 168° 00' 00" E)	*Bryum argenteum*	1989	(Paul A. Broady, 1989a)
	Bryum antarcticum	1989	(Paul A. Broady, 1989a)
	Sarconeurum glaciale	1989 1998 1999 2005	(Paul A. Broady, 1989a; Selkirk et al., 1997; R. D. Seppelt & Green, 1998; M. Skotnicki et al., 1999; M. L.

			Skotnicki et al., 2005)
	Hennediella heimii	1998	(R. D. Seppelt & Green, 1998)
	Bryum subrotundifolium	1998	(R. D. Seppelt & Green, 1998)
	Bryum pseudotriquetrum	1998	(R. D. Seppelt & Green, 1998)
Marble Point (77° 26' 00" S 163° 50' 00" E)	*Anomobryum subrotundifolium*	2007	(M. I. Stevens et al., 2007)
Cape Bird (77° 10' 00" S 166° 41' 00" E)	*Bryum subrotundifolium*	1998	(R. D. Seppelt & Green, 1998)
	Hennediella heimii	1998 2007	(R. D. Seppelt & Green, 1998; M. I. Stevens et al., 2007)
	Anomobryum subrotundifolium	2007	(M. I. Stevens et al., 2007)
Botany Bay (77° 00' 00" S 162° 35' 00" E)	*Grimmia antarctici*	1998	(C. Colesie et al., 2014; R. D. Seppelt & Green, 1998)
	Didymodon gelidus	1998	(C. Colesie et al., 2014; R. D. Seppelt & Green, 1998)
	Bryum subrotundifolium	1998 2005	(C. Colesie et al., 2014; Pannewitz et al., 2005; R. D. Seppelt & Green, 1998)
	Bryum argenteum	1998 2005 2010 2012 2014	(Claudia Colesie et al., 2014; Rodney D. Seppelt et al., 2010; M. L. Skotnicki et al., 2005; Mary L Skotnicki et al., 1998)
	Bryum pseudotriquetrum	1998 2005 2010 2014	(C. Colesie et al., 2014; Pannewitz et al., 2005; R. D. Seppelt & Green, 1998; Rodney D. Seppelt et al., 2010; M. L. Skotnicki et al., 2005)
	Ceratodon purpureus	1998 2005 2010 2012 2014	(C. Colesie et al., 2014; Pannewitz et al., 2005; B. Schroeter et al., 2012; R. D. Seppelt & Green, 1998; Rodney D. Seppelt et al., 2010; M. L. Skotnicki et al., 2005)
	Grimmia plagiopodia	1998 2010 2014	(C. Colesie et al., 2014; R. D. Seppelt & Green, 1998; Rodney D. Seppelt et al., 2010)
	Bryoerythrophyllum recurvirostrum	2005 2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010; M. L. Skotnicki et al.,

			2005)
	Hennediella heimii	2010 2012 2014	(C. Colesie et al., 2014; B. Schroeter et al., 2012; Rodney D. Seppelt et al., 2010)
	Didymodon brachyphyllus	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Schistidium antarctici	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Syntrichia sarconeurum	2010 2014	(C. Colesie et al., 2014; Rodney D. Seppelt et al., 2010)
	Cephaloziella varians	2014	(C. Colesie et al., 2014)
Beaufort Island (76° 56' 00" S 166° 56' 00" E)	*Bryum subrotundifolium*	1998 1999	(Rodney D Seppelt et al., 1999; R. D. Seppelt & Green, 1998)
	Hennediella heimii	1998 1999 2005	(Rodney D Seppelt et al., 1999; R. D. Seppelt & Green, 1998; M. L. Skotnicki et al., 2005)
	Bryum argenteum	2005	(M. L. Skotnicki et al., 2005)
	Anomobryum subrotundifolium	2007	(M. I. Stevens et al., 2007)
Kar Plateau (76° 56' 00" S 162° 20' 00" E)	*Bryum agenteum*	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Bryum pseudotriquetrum	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Grimmia antarctici	1998 1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
	Hennediella heimii	1998 1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999; R. D. Seppelt & Green, 1998)
	Grimmia plagiopodia	1998	(R. D. Seppelt & Green, 1998)
	Bryum subrotundifolium	1998	(R. D. Seppelt & Green, 1998)
	Sarconeurum glaciale	1999	(R. Seppelt et al., 1995; Rodney D Seppelt et al., 1999)
Mt de Gerlache (74° 59' 00" S 164° 30' 00" E)	*Bryum subrotundifolium*	1998	(R. D. Seppelt & Green, 1998)

Terra Nova Bay (74° 50' 00" S 164° 30' 00" E)	*Bryum argenteum*	2014	(C. Colesie et al., 2014)
	Bryum pseudotriquetrum	2014	(C. Colesie et al., 2014)
	Bryum archangelicum	2014	(C. Colesie et al., 2014)
	Bryum dichotomum	2014	(C. Colesie et al., 2014)
	Bryum pallescens	2014	(C. Colesie et al., 2014)
	Cephaloziella exiliflora	2014	(C. Colesie et al., 2014)
	Ceratodon purpureus	2014	(C. Colesie et al., 2014)
	Coscinodon lawianus	2014	(C. Colesie et al., 2014)
	Coscinodon reflexidens	2014	(C. Colesie et al., 2014)
	Grimmia anodon	2014	(C. Colesie et al., 2014)
	Hennediella heimii	2014	(C. Colesie et al., 2014)
	Orthogrimmia sessitana	2014	(C. Colesie et al., 2014)
	Schistidium antarctici	2014	(C. Colesie et al., 2014)
	Syntrichia magellanica	2014	(C. Colesie et al., 2014)
	Syntrichia princeps	2014	(C. Colesie et al., 2014)
	Syntrichia sarconeurum	2014	(C. Colesie et al., 2014)
Mt Browning (74° 37' 00" S 164° 03' 00" E)	*Grimmia plagiopodia*	1998	(R. D. Seppelt & Green, 1998)
Mount Melbourne (74° 21' 00" S 164° 42' 00" E)	*Campylopus pyriformis*	1987 2001 2005	(P. Broady et al., 1987; M. L. Skotnicki et al., 2005; M. L. Skotnicki, Selkirk, Broady, Adam, & Ninham, 2001)
Edmonson Point (74° 20' 00" S 165° 08' 00" E)	*Bryum subrotundifolium*	1998	(R. D. Seppelt & Green, 1998)
	Bryum argenteum	2005	(M. L. Skotnicki et al., 2005)
	Ceratodon purpureus	2005	(M. L. Skotnicki et al., 2005)
	Sarconeurum glaciale	2005	(M. L. Skotnicki et al., 2005)
Mount Erebus (73° 39' 00" S 170° 34' 00" E)	*Campylopus pyriformis*	2005	(M. L. Skotnicki et al., 2005)
Mount Rittmann (73° 28' 00" E 165° 37' 00" E)	*Pohlia nutans*	1996 2005	(Bargagli et al., 1996; M. L. Skotnicki et al., 2005)
Crater Cirque (72° 38' 00" S 169° 22' 00" E)	*Bryum pseudotriquetrum*	2005	(M. L. Skotnicki et al., 2005)
	Ceratodon purpureus	2005	(M. L. Skotnicki et al., 2005)
Cape Hallet (72° 19' 00" S 170° 16' 00" E)	*Sarconeurum glaciale*	1998	(R. D. Seppelt & Green, 1998)
	Bryum subrotundifolium	1998 2005	(Pannewitz et al., 2005; R. D. Seppelt & Green, 1998)
	Bryum pseudotriquetrum	2005	(Pannewitz et al., 2005)

	Anomobryum subrotundifolium	2007	(M. I. Stevens et al., 2007)
	Bryum pseudotriquetrum	2007 2014	(C. Colesie et al., 2014; M. I. Stevens et al., 2007)
	Ceratodon purpureus	2007 2014	(C. Colesie et al., 2014; M. I. Stevens et al., 2007)
	Bryum argenteum	2014	(C. Colesie et al., 2014)
	Didymodon brachyphyllus	2014	(C. Colesie et al., 2014)
	Hennediella heimii	2014	(C. Colesie et al., 2014)
	Schistidium antarctici	2014	(C. Colesie et al., 2014)
Birthday Ridge (71° 26' 00" S 169° 24' 00" E)	*Bryum algens*	1985	(Kappen, 1985)
Mt Gorton (70° 01' 00" S 159° 15' 00" E)	*Grimmia antarctici*	1998	(R. D. Seppelt & Green, 1998)

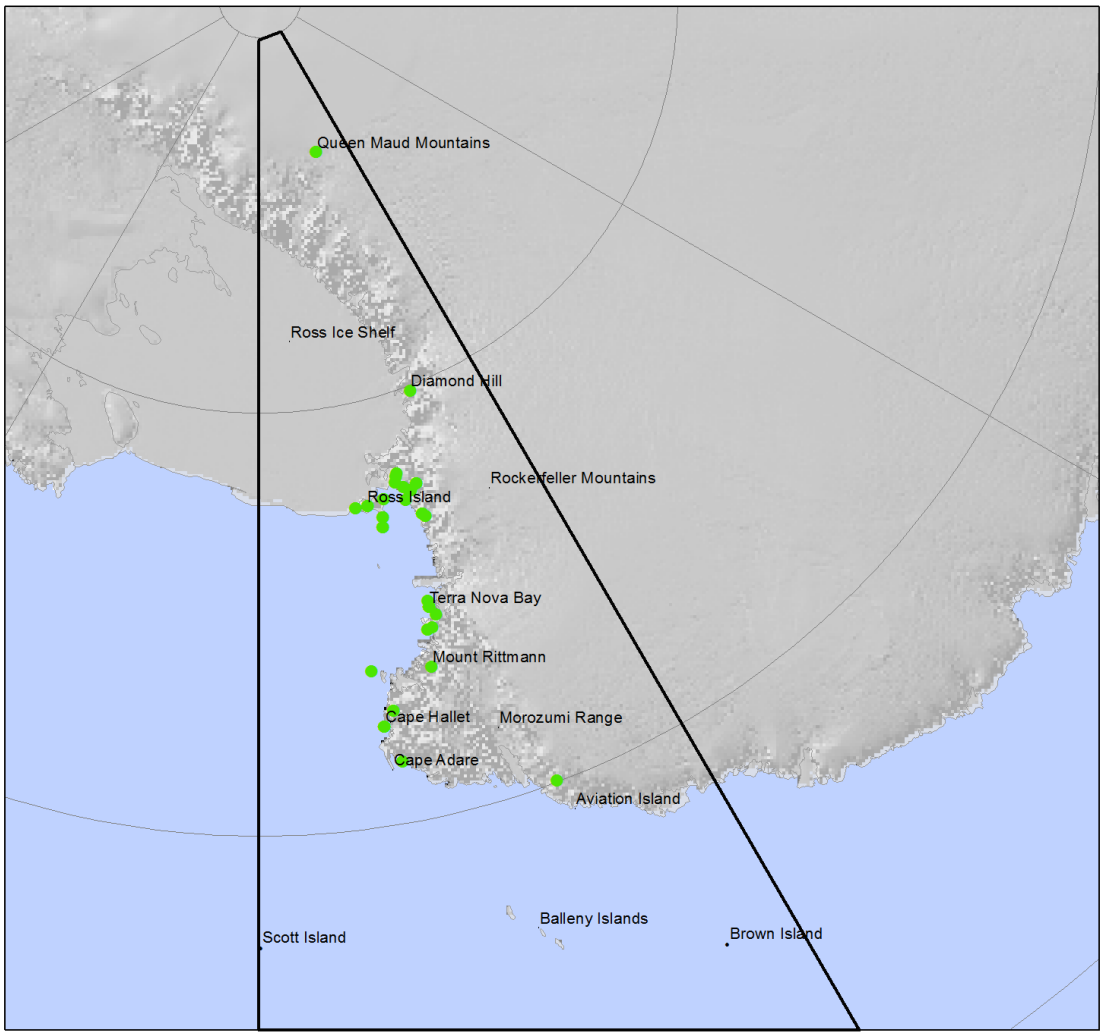

Figure 6. Map of moss colonies in the Ross Sea region

Table 6. Locations of liverworts colonies in the Ross Sea region

Location	Species	Year	Reference
Botany Bay (77° 00' 00" S 162° 35' 00" E)	*Cephaloziella exiliflora*	1998	(R. D. Seppelt & Green, 1998)
	Cephaloziella varians	2010	(Rodney D. Seppelt et al., 2010)
Mount Melbourne (74° 21' 00" S 164° 42' 00" E)	*Cephaloziella exiliflora*	1987 1998	(P. Broady et al., 1987; R. D. Seppelt & Green, 1998)
	Cephaloziella varians	2001	(M. L. Skotnicki et al., 2001)
Cape Hallett (72° 19' 00" S 170° 16' 00" E)	*Cephaloziella exiliflora*	1998	(R. D. Seppelt & Green, 1998)

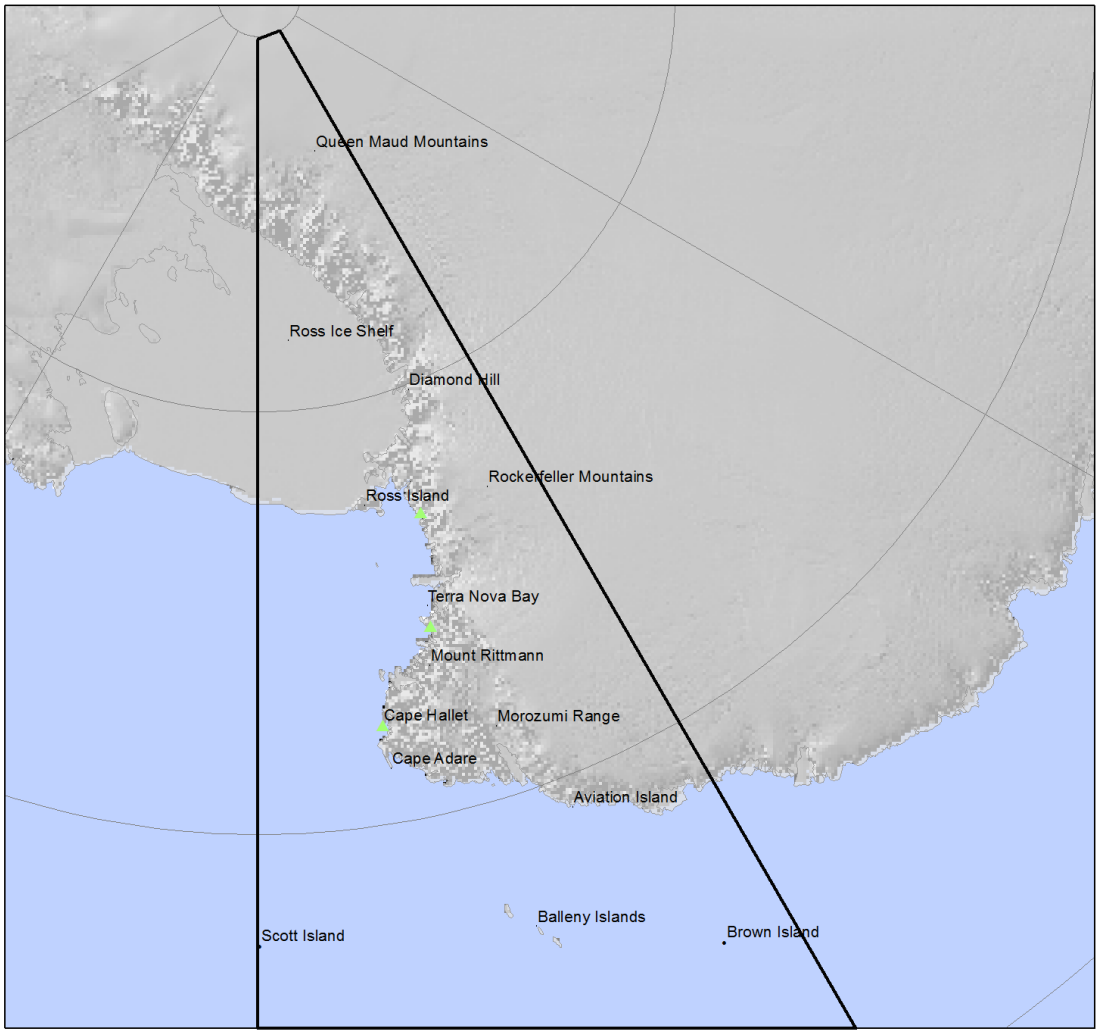

Figure 7. Map of liverwort colonies in the Ross Sea region

MICROORGANISMS (BACTERIA & PROTOZOA)

Microorganisms such as bacteria and protozoa are distributed throughout the soils of the Ross Sea region and play a very important role in biogeochemical cycles (J. M. Aislabie, Jordan, & Barker, 2008; Fountain, Tranter, Nylen, Lewis, & Mueller, 2004; Waterhouse, 2001). They are also found in lakes, ponds, streams and cryoconite holes (Waterhouse, 2001). Distribution is controlled by a range of factors such as slope, drainage, exposure, and nutrient and moisture availability (Jackie M. Aislabie et al., 2006). Bacterial community structures are highly heterogeneous and locally adapted, reflecting the local geochemistry of the soils (Bottos, Scarrow, Archer, McDonald, & Cary, 2014). Survival strategies of microorganisms include mixotrophy and efficient photosynthesis at low levels of photosynthetically active radiation (Roberts, Laybourn-Parry, McKnight, & Novarino, 2000). Early investigations of the bacterial diversity in Antarctica were hindered by the lack of appropriate methods (J. M. Aislabie et al., 2008). This study found 20 species of bacteria (Table 7) (Figure 8) and 49 species of protozoa (Table 8) (Figure 9).

Table 7. Locations of bacteria colonies in the Ross Sea region

Location	Species	Year	Reference
Mt. Fleming (77° 33' 00" S 160° 06' 00" E)	*Gillisia mitskevichiae*	2006	(Jackie M. Aislabie et al., 2006)
	Hymenobacter roseosalivarius	2006	(Jackie M. Aislabie et al., 2006)
	Pontibacter actiniarum	2006	(Jackie M. Aislabie et al., 2006)
	Sedimentibacter rubrus	2006	(Jackie M. Aislabie et al., 2006)
Lake Vanda (77° 31' 47" S 161° 34' 32" E)	*Chomatium vanda*	1978	(Osnitskaia & Chudina, 1978)
	Gillisia mitskevichiae	2006	(Jackie M. Aislabie et al., 2006)
	Hymenobacter roseosalivarius	2006	(Jackie M. Aislabie et al., 2006)
	Pontibacter actiniarum	2006	(Jackie M. Aislabie et al., 2006)
	Sedimentibacter rubrus	2006	(Jackie M. Aislabie et al., 2006)

Wright Valley (77° 31' 00" S 161° 50' 00" E)	*Gillisia mitskevichiae*	2006	(Jackie M. Aislabie et al., 2006)
	Hymenobacter roseosalivarius	2006	(Jackie M. Aislabie et al., 2006)
	Pontibacter actiniarum	2006	(Jackie M. Aislabie et al., 2006)
	Sedimentibacter rubrus	2006	(Jackie M. Aislabie et al., 2006)
	Deinococcus thermus	2014	(Bottos et al., 2014)
	Rubrobacter	2014	(Bottos et al., 2014)
	Bacteroidetes	2014	(Bottos et al., 2014)
	Acidobacteria	2014	(Bottos et al., 2014)
Marble Point (77° 26' 00" S 163° 50' 00" E)	*Gillisia mitskevichiae*	2006	(Jackie M. Aislabie et al., 2006)
	Hymenobacter roseosalivarius	2006	(Jackie M. Aislabie et al., 2006)
	Pontibacter actiniarum	2006	(Jackie M. Aislabie et al., 2006)
	Sedimentibacter rubrus	2006	(Jackie M. Aislabie et al., 2006)
Mount Melbourne (74° 21' 00" S 164° 42' 00" E)	*Bacillus fumarioli*	2000	(Logan et al., 2000)
	Alicyclobacillus pohliae	2008	(Imperio, Viti, & Marri, 2008)
Mount Erebus (73° 39' 00" S 170° 34' 00" E)	*Bacillus schlegelii*	1988	(Hudson & Daniel, 1988)
	Sulfolobus spp	1988	(Hudson & Daniel, 1988)
	Thermoplasma spp	1988	(Hudson & Daniel, 1988)
	Bacillus acidocaldarius	1988	(Hudson & Daniel, 1988)
	Thermoproteus spp.	1988	(Hudson & Daniel, 1988)
Mount Rittman (73° 28' 00" E 165° 37' 00" E)	*Bacillus fumarioli*	2000	(Logan et al., 2000)
Cape Hallet (72° 19' 00" S 170° 16' 00" E)	*Xanthomonadaceae*	2009	(J. Aislabie et al., 2009)
	Rhodanobacter	2009	(J. Aislabie et al., 2009)
	Moraxellaceae	2009	(J. Aislabie et al., 2009)
	Ectothiorhodopsira shapsohnikoviii	2009	(J. Aislabie et al., 2009)

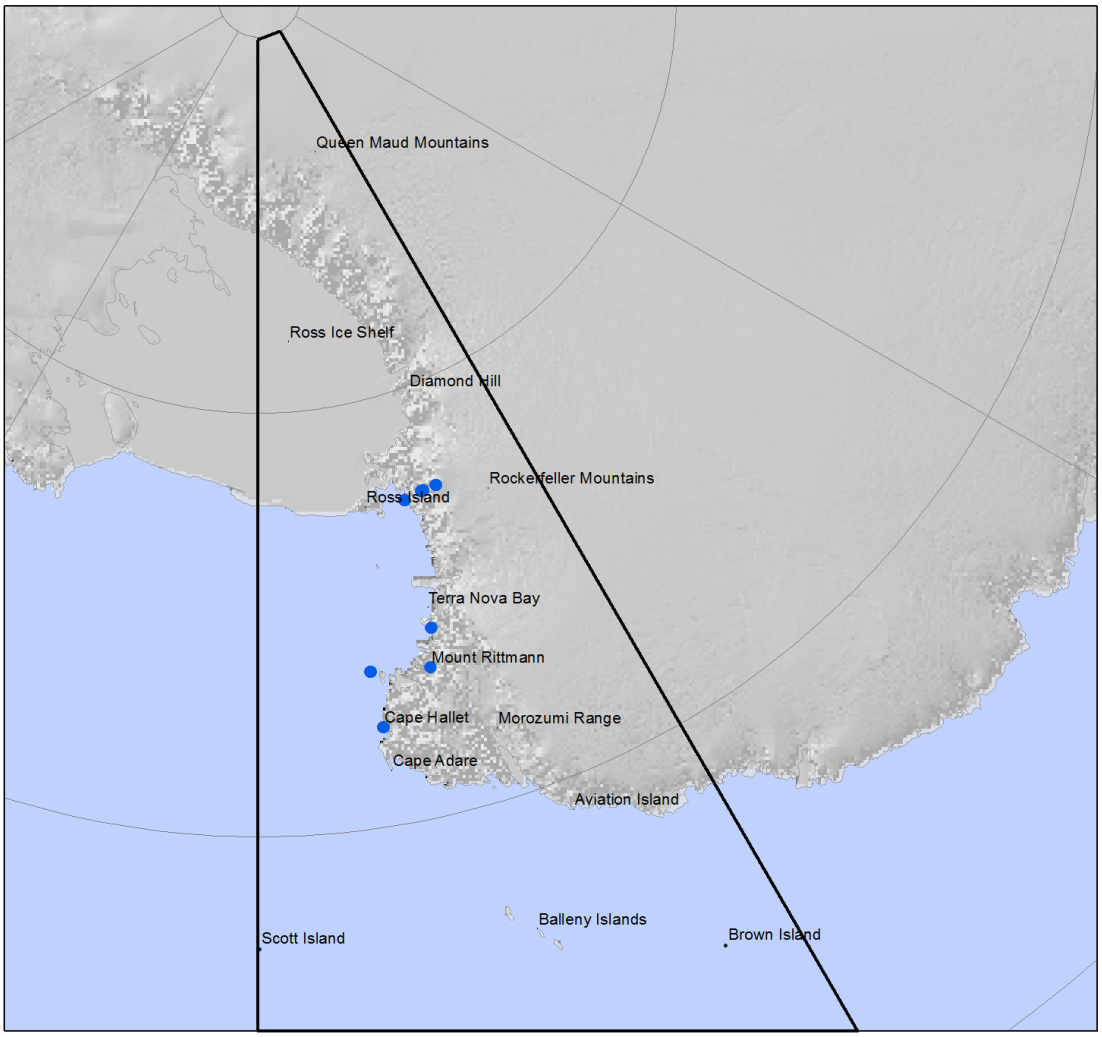

Figure 8. Map of bacteria colonies in the Ross Sea region

Table 8. Locations of protozoa colonies in the Ross Sea region

Location	Species	Year	Reference
Lake Miers (78° 06' 00" S 164° 00' 00" E)	*Anisonema*	1981	(Cathey, Parker, Simmons Jr, Yongue Jr, & Van Brunt, 1981)
	Bodo	1981	(Cathey et al., 1981)
	Amoeba	1981	(Cathey et al., 1981)
	Actinophyrys	1981	(Cathey et al., 1981)
	Acanthocystis	1981	(Cathey et al., 1981)
	Spathidium	1981	(Cathey et al., 1981)
	Chilodonella	1981	(Cathey et al., 1981)
	Nassula	1981	(Cathey et al., 1981)
	Saprophilus	1981	(Cathey et al., 1981)
	Pleuronema	1981	(Cathey et al., 1981)
	Oxytricha	1981	(Cathey et al., 1981)
	Amphisiella	1981	(Cathey et al., 1981)
	Holosticha	1981	(Cathey et al., 1981)
	Euplotes	1981	(Cathey et al., 1981)

	Vorticella	1981	(Cathey et al., 1981)
	Pyxidium	1981	(Cathey et al., 1981)
	Podophrya	1981	(Cathey et al., 1981)
	Sphaerophrya	1981	(Cathey et al., 1981)
McMurdo Ice Shelf melt ponds (78° 00' 00" S 166° 30' 00" E)	*Prorodon*	1995	(James, Pridmore, & Cummings, 1995)
	Epistylis	1995	(James et al., 1995)
	Aspidisca	1995	(James et al., 1995)
	Colpoda	1995	(James et al., 1995)
	Tetrahymaena	1995	(James et al., 1995)
	Enchelys	1995	(James et al., 1995)
	Vorticeila	1995	(James et al., 1995)
	Euplotes	1995	(James et al., 1995)
	Cinetochilum	1995	(James et al., 1995)
	Urotricha	1995	(James et al., 1995)
	Nassula	1995	(James et al., 1995)
	Chiiodoneila	1995	(James et al., 1995)
	Nassula	1995	(James et al., 1995)
	Halteria	1995	(James et al., 1995)
	Bursellopsis	1995	(James et al., 1995)
Lake Bonney (77° 44' 00" S 162° 10' 00" E)	*Amoeba*	1981	(Cathey et al., 1981)
	Holophrya	1981	(Cathey et al., 1981)
	Nassula	1981	(Cathey et al., 1981)
	Halteria	1981	(Cathey et al., 1981)
	Amphisiella	1981	(Cathey et al., 1981)
	Holosticha	1981	(Cathey et al., 1981)
Lake Joyce (77° 43' 00" S 161° 37' 00" E)	*Acanthocystis*	1981	(Cathey et al., 1981)
	Holophyra	1981	(Cathey et al., 1981)
	Saprophilus	1981	(Cathey et al., 1981)
	Pleuronema	1981	(Cathey et al., 1981)
	Halteria	1981	(Cathey et al., 1981)
	Vorticella	1981	(Cathey et al., 1981)
Lake Chad (77° 39' 00" S 162° 46' 00" E)	*Anisonema*	1981	(Cathey et al., 1981)
	Notosolenus	1981	(Cathey et al., 1981)
	Bodo	1981	(Cathey et al., 1981)
	Gromia	1981	(Cathey et al., 1981)
	Actinophyrys	1981	(Cathey et al., 1981)
	Nassula	1981	(Cathey et al., 1981)
	Colpoda	1981	(Cathey et al., 1981)
	Halteria	1981	(Cathey et al., 1981)
	Euplotes	1981	(Cathey et al., 1981)
	Vorticella	1981	(Cathey et al., 1981)
	Epistylis	1981	(Cathey et al., 1981)
Lake Hoare (77° 38' 00" S 162° 52' 00" E)	*Amoeba*	1981	(Cathey et al., 1981)
	Gromia	1981	(Cathey et al., 1981)
	Euplotes	1981 1982	(Cathey et al., 1981; Cathey, Simmons, Parker,

			Yongue, & Van Brunt, 1982)
	Vorticella sp.	1981 1999	(Cathey et al., 1981; Kepner Jr, Wharton Jr, & Coats, 1999)
	Oxytrichia	1982	(Cathey et al., 1982)
	Halteria	1982	(Cathey et al., 1982)
	Askenasia sp.	1999	(Kepner Jr et al., 1999)
	Blepharisma sp.	1999	(Kepner Jr et al., 1999)
	Cyclidium sp.	1999	(Kepner Jr et al., 1999)
	Monodinium sp.	1999	(Kepner Jr et al., 1999)
	Plagiocampa sp.	1999	(Kepner Jr et al., 1999)
	Urotricha sp.	1999	(Kepner Jr et al., 1999)
Lake Fryxwell (77° 37' 00" S 163° 11' 00" E)	*Spathidium*	1981	(Cathey et al., 1981)
	Homalozoon	1981	(Cathey et al., 1981)
	Oxytricha	1981	(Cathey et al., 1981)
	Enchelydon sp.	1982 1999	(Cathey et al., 1982; Roberts et al., 2000)
	Mesodinium	1982 2000	(Cathey et al., 1982)
	Holophrya	1982	(Cathey et al., 1982)
	Didinium balbianii	1982	(Cathey et al., 1982)
	Nassula sp.	1982 2000	(Cathey et al., 1982; Roberts et al., 2000)
	Vorticella	1982 1999	(Cathey et al., 1982; Kepner Jr et al., 1999)
	Cyclidium sp.	1999	(Kepner Jr et al., 1999)
	Cyclotrichium sp.	1999	(Kepner Jr et al., 1999)
	Uronema sp	1999	(Kepner Jr et al., 1999)
	Askenasia sp.	1999 2000	(Kepner Jr et al., 1999; Roberts et al., 2000)
	Monodinium species	1999 2000	(Kepner Jr et al., 1999; Roberts et al., 2000)
	Euplotes sp.	1999 2000	(Kepner Jr et al., 1999; Roberts et al., 2000)
	Frontonia sp.	1999 2000	(Kepner Jr et al., 1999; Roberts et al., 2000)
	Plagiocampa sp.	2000	(Roberts et al., 2000)
	Urotricha sp.	2000	(Roberts et al., 2000)
	Halteria sp.	2000	(Roberts et al., 2000)
	Strombidium sp.	2000	(Roberts et al., 2000)
	Didinium sp.	2000	(Roberts et al., 2000)
	Pyramimonas sp.	2000	(Roberts et al., 2000)
	Chlamydomonas sp	2000	(Roberts et al., 2000)
	Cryptomonas undulata	2000	(Roberts et al., 2000)
	Bursaria	2000	(Roberts et al., 2000)
	Vorticella species	2000	(Roberts et al., 2000)
	Sphaerophrya sp.	2000	(Roberts et al., 2000)

	Blepharisma sp.	2000	(Roberts et al., 2000)
	Lacrymaria sp.	2000	(Roberts et al., 2000)
Lake Vanda (77° 31' 47" S 161° 34' 32" E)	*Anisonema*	1981	(Cathey et al., 1981)
	Amoeba	1981	(Cathey et al., 1981)
	Oxytricha	1981	(Cathey et al., 1981)
	Amphisiella	1981	(Cathey et al., 1981)
	Holosticha	1981	(Cathey et al., 1981)
	Vorticella	1981	(Cathey et al., 1981)
Lake Brownworth (77° 26' 00" S 162° 45' 00" E)	*Bodo*	1981	(Cathey et al., 1981)
	Amoeba	1981	(Cathey et al., 1981)
	Actinophyrys	1981	(Cathey et al., 1981)
	Spathidium	1981	(Cathey et al., 1981)
	Nassula	1981	(Cathey et al., 1981)
	Holosticha	1981	(Cathey et al., 1981)
	Euplotes	1981	(Cathey et al., 1981)
	Podophrya	1981	(Cathey et al., 1981)

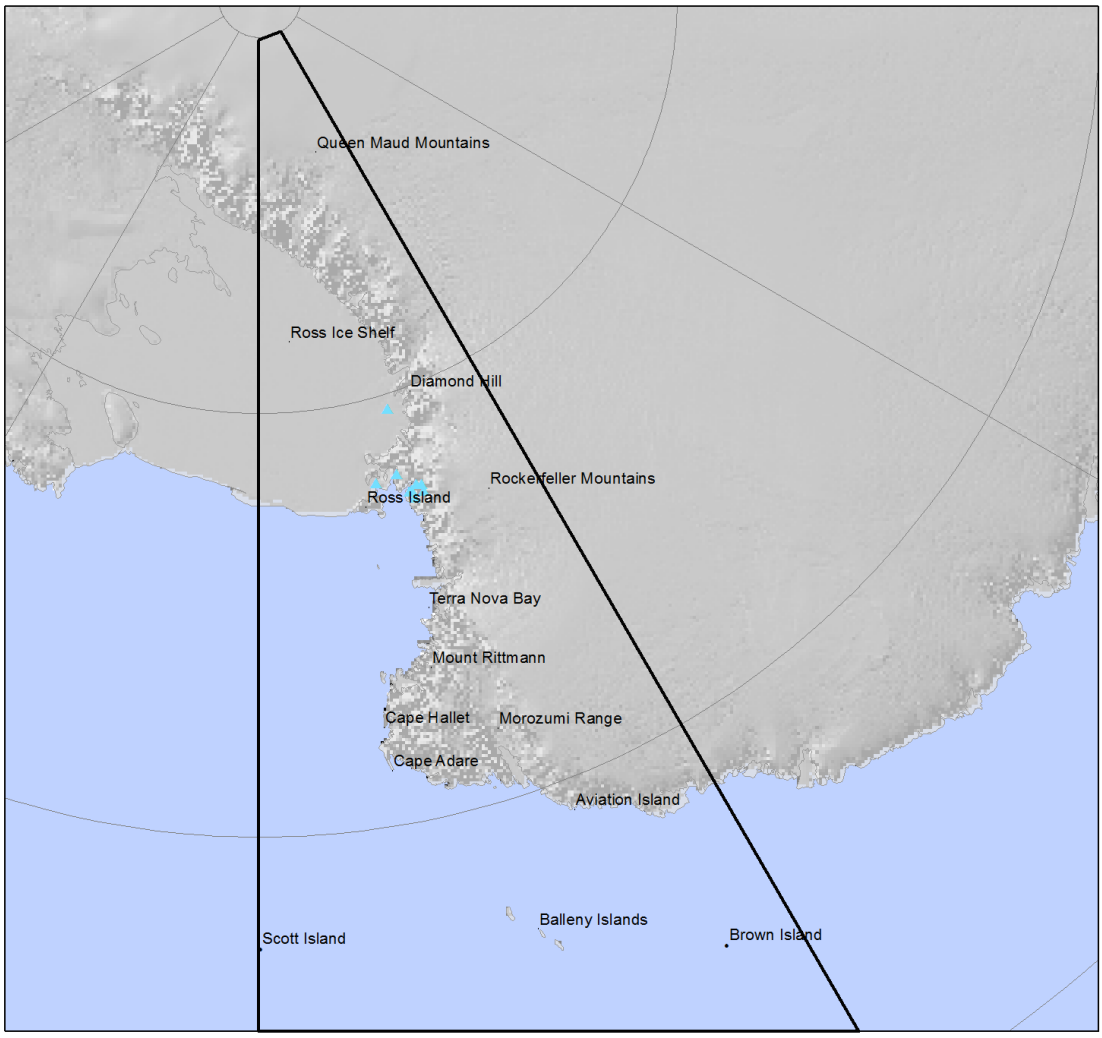

Figure 9. Map of protozoa colonies in the Ross Sea region

MESOFAUNA (ROTIFERS, TARDIGRADES & NEMATODES)

The mesofauna in Antarctica is comprised of rotifers, tardigrades and nematodes. They are found in the soils and vegetation of ice free areas, and are a an important component of the simple food webs in these low diversity areas (Porazinska, Wall, & Virginia, 2002; Schwarz, Green, Green, & Seppelt, 1993). Their distribution is also related to the soil geochemistry of the ice-free areas, such as the McMurdo Dry Valleys (Poage, Barrett, Virginia, & Wall, 2008). To survive in these extreme environments, these microscopic invertbrates spend a lot of time inactive and uncoupled from ecosystem processes in an anhydrobiotic survival state. Nematodes can lose more than 95% of their water content in this state but are resistant to environmental stresses (Treonis, Wall, & Virginia, 1999). There are 20 species of rotifer and 8 species of nematode and tardigrade in the Ross Sea region (Table 9, 10, 11) (Figure 10, 11, 12). They are often not identified to the species level; only their presence is noted and studies are concentrated around Ross Island.

Table 9. Locations of rotifer colonies in the Ross Sea region

Location	Species	Year	Reference
Walcott Glacier (78° 14' 00" S 163° 15' 00" E)	*Adineta barbata*	1963	(Dougherty & Harris, 1963)
	Adineta sp.	1963	(Dougherty & Harris, 1963)
	Habrotrocha constrictus	1963	(Dougherty & Harris, 1963)
	Macrotrachela habita	1963	(Dougherty & Harris, 1963)
	Philodina antarctica	1963	(Dougherty & Harris, 1963)
	Philodina gregaria	1963	(Dougherty & Harris, 1963)
	Cephalodella tenuior	1963	(Dougherty & Harris, 1963)
	Collotheca ornata var. cornuta	1963	(Dougherty & Harris, 1963)
Hobbs Glacier (77° 54' 00" S 164° 24' 00" E)	*Adineta barbata*	1963	(Dougherty & Harris, 1963)
	Adineta grandis	1963	(Dougherty & Harris, 1963)
	Habrotrocha constrictus	1963	(Dougherty & Harris, 1963)
	Macrotrachela habita	1963	(Dougherty & Harris, 1963)
	Philodina antarctica	1963	(Dougherty & Harris, 1963)
	Philodina gregaria	1963	(Dougherty & Harris, 1963)
	Cephalodella tenuior	1963	(Dougherty & Harris, 1963)
	Collotheca ornata var. cornuta	1963	(Dougherty & Harris, 1963)

	Epiphanes senta	1963	(Dougherty & Harris, 1963)
	Pleurotrocha sp.	1963	(Dougherty & Harris, 1963)
	Loricate form	1963	(Dougherty & Harris, 1963)
	Notammatid sp.	1963	(Dougherty & Harris, 1963)
Blue Glacier (77° 50' 00" S 164° 10' 00" E)	*Adineta grandis*	1963	(Dougherty & Harris, 1963)
	Habrotrocha constrictus	1963	(Dougherty & Harris, 1963)
	Macrotrachela habita	1963	(Dougherty & Harris, 1963)
	Philodina antarctica	1963	(Dougherty & Harris, 1963)
	Philodina gregaria	1963	(Dougherty & Harris, 1963)
	Collotheca ornata var. cornuta	1963	(Dougherty & Harris, 1963)
McMurdo Station (77° 50' 52" S 166° 40' 06" E)	*Adineta barbata*	1963	(Dougherty & Harris, 1963)
	Adineta grandis	1963	(Dougherty & Harris, 1963)
	Adineta sp.	1963	(Dougherty & Harris, 1963)
	Habrotrocha constrictus	1963	(Dougherty & Harris, 1963)
	Macrotrachela habita	1963	(Dougherty & Harris, 1963)
	Philodina alata	1963	(Dougherty & Harris, 1963)
	Philodina gregaria	1963	(Dougherty & Harris, 1963)
	Pleurotrocha sp.	1963	(Dougherty & Harris, 1963)
	Notammatid sp.	1963	(Dougherty & Harris, 1963)
Beacon Valley (77° 49' 00" S 160° 39' 00" E)	*Unidentified species*	2005	(Bamforth, Wall, & Virginia, 2005)
Stranded Moraines (77° 45' 00" S 164° 31' 00" E)	*Adineta grandis*	1963	(Dougherty & Harris, 1963)
	Habrotrocha constrictus	1963	(Dougherty & Harris, 1963)
	Philodina alata	1963	(Dougherty & Harris, 1963)
	Philodina gregaria	1963	(Dougherty & Harris, 1963)
Taylor Valley (77° 44' 00" S 162° 10' 00" E)	*Adineta barbata*	1963	(Dougherty & Harris, 1963)
	Adineta grandis	1963	(Dougherty & Harris, 1963)
	Habrotrocha constrictus	1963	(Dougherty & Harris, 1963)
	Macrotrachela habita	1963	(Dougherty & Harris, 1963)
	Philodina alata	1963	(Dougherty & Harris, 1963)
	Philodina gregaria	1963	(Dougherty & Harris, 1963)
	Collotheca ornata var. cornuta	1963	(Dougherty & Harris, 1963)
	Epiphanes senta	1963	(Dougherty & Harris, 1963)
	Loricate form	1963	(Dougherty & Harris, 1963)
	Notammatid sp.	1963	(Dougherty & Harris, 1963)
	Unidentified species	1999 2003	(Moorhead, Barrett, Virginia, Wall, & Porazinska, 2003; Treonis et al., 1999)
Edward VII Peninsula (77° 40' 00" S	*Philodina gregaria*	1989	(P. A. Broady, Adams, Cleary, & Weaver, 1989)
	Philodina sp.	1989	(P. A. Broady et al., 1989)

155° 00' 00" W)	*Adineta gracilis*	1989	(P. A. Broady et al., 1989)
	Habrotrocha sp.	1989	(P. A. Broady et al., 1989)
Lake Hoare (77° 38' 00" S 162° 52' 00" E)	*Unidentified species*	1998	(Powers, Ho, Freckman, & Virginia, 1998)
Canada Glacier (77° 37' 00" S 162° 59' 00" E)	*Philodina sp.*	1993	(Schwarz et al., 1993)
	Habrotrocha sp.	1993	(Schwarz et al., 1993)
	Epiphanes sp.	1993	(Schwarz et al., 1993)
Lake Fryxwell (77° 37' 00" S 163° 11' 00" E)	*Unidentified species*	1989 2005	(Bamforth et al., 2005; Wharton & Brown, 1989)
Daily Islands (77° 36' 00" S 163° 51' 00" E)	*Adineta barbata*	1963	(Dougherty & Harris, 1963)
	Adineta grandis	1963	(Dougherty & Harris, 1963)
	Habrotrocha angularis	1963	(Dougherty & Harris, 1963)
	Habrotrocha constrictus	1963	(Dougherty & Harris, 1963)
	Philodina antarctica	1963	(Dougherty & Harris, 1963)
	Philodina gregaria	1963	(Dougherty & Harris, 1963)
	Cephalodella tenuior	1963	(Dougherty & Harris, 1963)
	Collotheca ornata var. cornuta	1963	(Dougherty & Harris, 1963)
	Epiphanes senta	1963	(Dougherty & Harris, 1963)
	Notammatid sp.	1963	(Dougherty & Harris, 1963)
Cape Barne (77° 35' 00" S 166° 14' 00" E)	*Philodina gregaria*	1963	(Dougherty & Harris, 1963)
Cape Royds (77° 35' 00" S 166° 10' 00" E)	*Adineta barbata*	1963	(Dougherty & Harris, 1963)
	Adineta grandis	1963	(Dougherty & Harris, 1963)
	Habrotrocha angularis	1963	(Dougherty & Harris, 1963)
	Habrotrocha constrictus	1963	(Dougherty & Harris, 1963)
	Macrotrachela habita	1963	(Dougherty & Harris, 1963)
	Philodina alata	1963	(Dougherty & Harris, 1963)
	Philodina antarctica	1963	(Dougherty & Harris, 1963)
	Philodina gregaria	1963	(Dougherty & Harris, 1963)
	Cephalodella tenuior	1963	(Dougherty & Harris, 1963)
	Collotheca ornata var. cornuta	1963	(Dougherty & Harris, 1963)
	Epiphanes senta	1963	(Dougherty & Harris, 1963)
	Pleurotrocha sp.	1963	(Dougherty & Harris, 1963)
	Loricate form	1963	(Dougherty & Harris, 1963)
	Notammatid sp.	1963	(Dougherty & Harris, 1963)
	Unidentified species	1989 2002	(Porazinska et al., 2002; Wharton & Brown, 1989)
Lake Canopus (77° 33' 00" S 161° 31' 00" E)	*Unidentified species*	1989	(Wharton & Brown, 1989)
Lake Vanda	*Unidentified species*	1989	(Wharton & Brown, 1989)

(77° 31' 47" S 161° 34' 32" E)			
Wright Dry Valley (77° 31' 00" S 161° 50' 00" E)	*Habrotrocha constrictus*	1963	(Dougherty & Harris, 1963)
	Macrotrachela habita	1963	(Dougherty & Harris, 1963)
	Philodina alata	1963	(Dougherty & Harris, 1963)
	Philodina gregaria	1963	(Dougherty & Harris, 1963)
Cape Crozier (77° 31' 00" S 169° 24' 00" E)	*Unidentified species*	2002	(Porazinska et al., 2002)
Ross Island (77° 30' 00" S 168° 11' 00" E)	*Unidentified species*	1989	(Wharton & Brown, 1989)
Bull Pass (77° 28' 00" S 163° 11' 00" E)	*Unidentified species*	2005	(Bamforth et al., 2005)
McKelvey Valley (77° 26' 00" S 161° 45' 00" E)	*Unidentified species*	2005	(Bamforth et al., 2005)
Marble Point (77° 26' 00" S 163° 50' 00" E)	*Adineta grandis*	1963	(Dougherty & Harris, 1963)
	Adineta sp.	1963	(Dougherty & Harris, 1963)
	Habrotrocha angularis	1963	(Dougherty & Harris, 1963)
	Habrotrocha constrictus	1963	(Dougherty & Harris, 1963)
	Macrotrachela habita	1963	(Dougherty & Harris, 1963)
	Philodina alata	1963	(Dougherty & Harris, 1963)
	Philodina antarctica	1963	(Dougherty & Harris, 1963)
	Philodina gregaria	1963	(Dougherty & Harris, 1963)
	Collotheca ornata var. cornuta	1963	(Dougherty & Harris, 1963)
	Pleurotrocha sp.	1963	(Dougherty & Harris, 1963)
	Loricate form	1963	(Dougherty & Harris, 1963)
	Notammatid sp.	1963	(Dougherty & Harris, 1963)
Cape Bird (77° 10' 00" S 166° 41' 00" E)	*Unidentified species*	1989 2002	(Porazinska et al., 2002; Wharton & Brown, 1989)

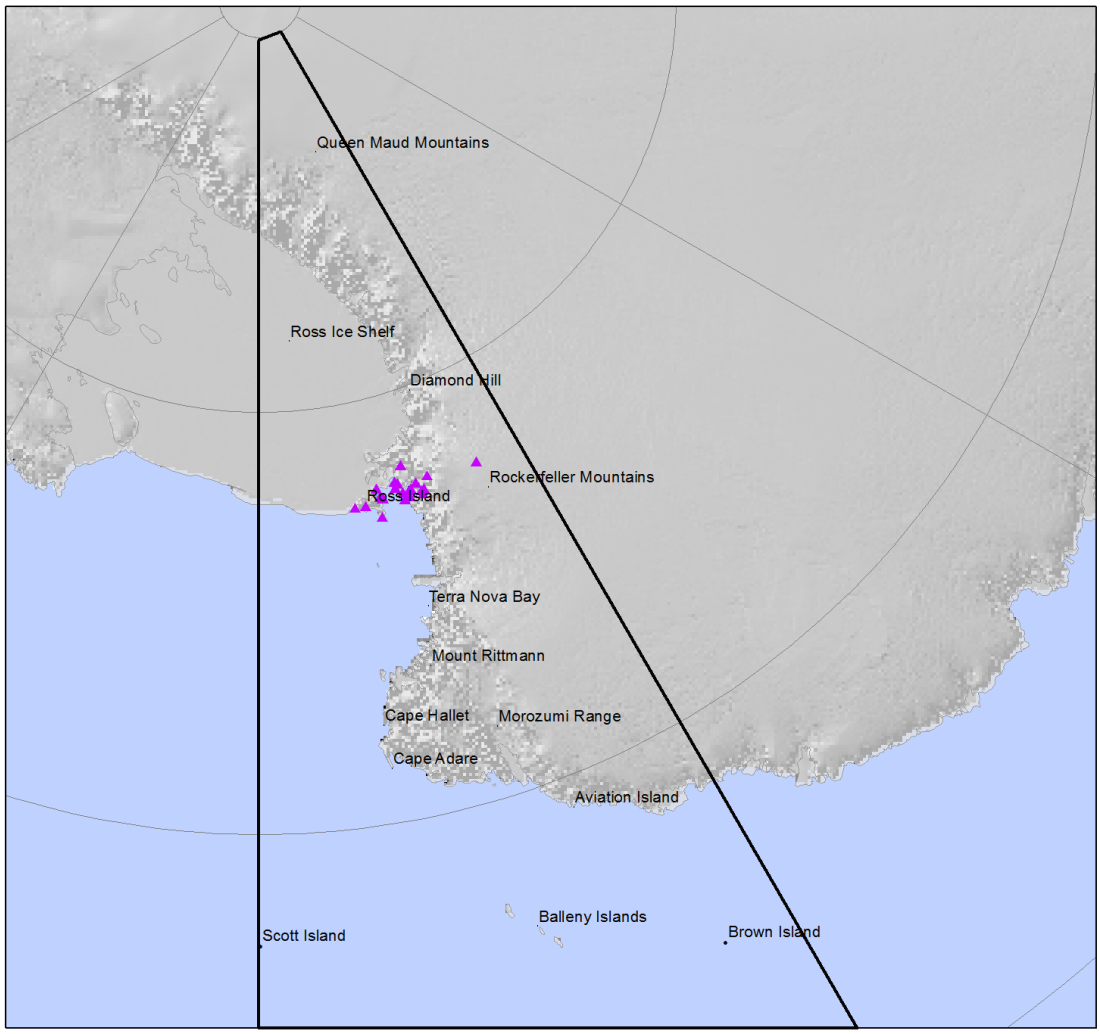

Figure 10. Map of rotifer colonies in the Ross Sea region

Table 10. Locations of tardigrade colonies in the Ross Sea region

Location	Species	Year	Reference
Hobbs Glacier (77° 54' 00" S 164° 24' 00" E)	*Hypsibius alpinus*	1963	(Dougherty & Harris, 1963)
	Hypsibius arcticus	1963	(Dougherty & Harris, 1963)
Blue Glacier (77° 50' 00" S 164° 10' 00" E)	*Hypsibius arcticus*	1963	(Dougherty & Harris, 1963)
McMurdo Station (77° 50' 52" S 166° 40' 06" E)	*Hypsibius alpinus*	1963	(Dougherty & Harris, 1963)
	Hypsibius arcticus	1963	(Dougherty & Harris, 1963)
Crater Hill (77° 50' 00" S 166° 43' 00" E)	*Unidentified species*	1989	(Wharton & Brown, 1989)
Beacon Valley (77° 49' 00" S 160° 39' 00" E)	*Unidentified species*	2005	(Bamforth et al., 2005)
Stranded	*Hypsibius oberhaeuseri*	1963	(Dougherty & Harris, 1963)

Moraines (77° 45' 00" S 164° 31' 00" E)			
Taylor Valley (77° 44' 00" S 162° 10' 00" E)	*Hypsibius alpinus*	1963	(Dougherty & Harris, 1963)
	Hypsibius arcticus	1963	(Dougherty & Harris, 1963)
	Hypsibius oberhaeuseri	1963	(Dougherty & Harris, 1963)
	Macrobiotus polaris	1963	(Dougherty & Harris, 1963)
	Unidentified species	1999 2003	(Moorhead et al., 2003; Treonis et al., 1999)
Edward VII Peninsula (77° 40' 00" S 155° 00' 00" W)	*Hypsibius sp.*	1989	(P. A. Broady et al., 1989)
	Echiniscus sp.	1989	(P. A. Broady et al., 1989)
Cape Evans (77° 38' 00" S 166° 24' 00" E)	*Hypsibius arcticus*	1963	(Dougherty & Harris, 1963)
Lake Hoare (77° 38' 00" S 162° 51' 00" E)	*Unidentified species*	1998	(Powers et al., 1998)
Canada Glacier (77° 37' 00" S 162° 59' 00" E)	*Macrobiotus spp.*	1993	(Schwarz et al., 1993)
Lake Fryxwell (77° 37' 00" S 163° 11' 00" E)	*Unidentified species*	1989 2005	(Bamforth et al., 2005; Wharton & Brown, 1989)
Daily Islands (77° 36' 00" S 163° 51' 00" E)	*Hypsibius arcticus*	1963	(Dougherty & Harris, 1963)
	Hypsibius oberhaeuseri	1963	(Dougherty & Harris, 1963)
Cape Royds (77° 35' 00" S 166° 10' 00" E)	*Hypsibius alpinus*	1963	(Dougherty & Harris, 1963)
	Hypsibius arcticus	1963	(Dougherty & Harris, 1963)
	Hypsibius oberhaeuseri	1963	(Dougherty & Harris, 1963)
	Unidentified species	1989 2002	(Porazinska et al., 2002; Wharton & Brown, 1989)
Lake Canopus (77° 33' 00" S 161° 31' 00" E)	*Unidentified species*	1989	(Wharton & Brown, 1989)
Lake Vanda (77° 31' 47" S 161° 34' 32" E)	*Unidentified species*	1989	(Wharton & Brown, 1989)
Wright Dry Valley (77° 31' 00" S 161° 50' 00" E)	*Hypsibius arcticus*	1963	(Dougherty & Harris, 1963)
Cape Crozier (77° 31' 00" S 169° 24' 00" E)	*Unidentified species*	2002	(Porazinska et al., 2002)
Ross Island (77° 30' 00" S	*Unidentified species*	1989	(Wharton & Brown, 1989)

168° 11' 00" E)			
Bull Pass (77° 28' 00" S 161° 42' 00" E)	*Unidentified species*	2005	(Bamforth et al., 2005)
McKelvey Valley (77° 26' 00" S 161° 33' 00" E)	*Unidentified species*	2005	(Bamforth et al., 2005)
Marble Point (77° 26' 00" S 163° 50' 00" E)	*Hypsibius alpinus*	1963	(Dougherty & Harris, 1963)
	Hypsibius arcticus	1963	(Dougherty & Harris, 1963)
	Hypsibius oberhaeuseri	1963	(Dougherty & Harris, 1963)
	Macrobiotus polaris	1963	(Dougherty & Harris, 1963)
Cape Bird (77° 10' 00" S 166° 41' 00" E)	*Unidentified species*	1989	(Wharton & Brown, 1989)
Brown Island (64° 58' 00" S 63° 47' 00" W)	*Hypsibius alpinus*	1963	(Dougherty & Harris, 1963)
	Hypsibius arcticus	1963	(Dougherty & Harris, 1963)
	Hypsibius oberhaeuseri	1963	(Dougherty & Harris, 1963)

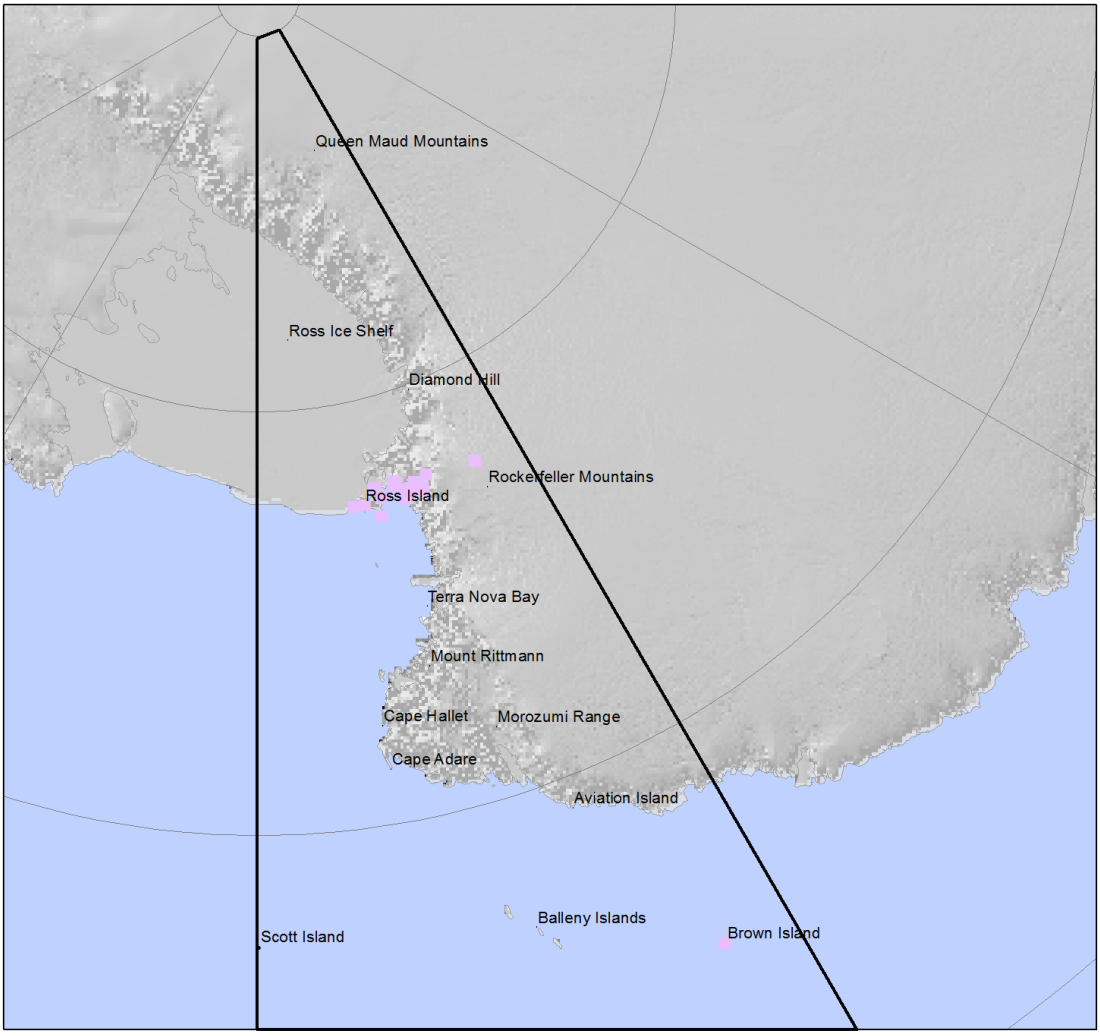

Figure 11. Map of tardigrade colonies in the Ross Sea region

Table 11. Locations of nematode colonies in the Ross Sea region

Location	Species	Year	Reference
Miers Valley (78° 06' 00" S 164° 00' 00" E)	*Scottnema lindsayae*	2005	(Bamforth et al., 2005)
	Plectus antarcticus	2005	(Bamforth et al., 2005)
	Eudorylaimus antarcticus	2005	(Bamforth et al., 2005)
Crater Hill (77° 50' 00" S 166° 43' 00" E)	*Scottnema lindsayae*	1989	(Wharton & Brown, 1989)
	Eudorylaimus antarcticus	1989	(Wharton & Brown, 1989)
	Plectus antarcticus	1989	(Wharton & Brown, 1989)
Beacon Valley (77° 49' 00" S 160° 39' 00" E)	*Scottnema lindsayae*	2005	(Bamforth et al., 2005)
Taylor Valley (77° 44' 00" S 162° 10' 00" E)	*Eudorylaimus antarcticus*	1999 2012	(Smith et al., 2012; Treonis et al., 1999)
	Plectus antarcticus	1999 2003	(Moorhead et al., 2003; Treonis et al., 1999)
	Scottnema lindsayae	2003 2012	(Moorhead et al., 2003; Smith et al., 2012; Treonis et al., 1999)
	Plectus murrayi	2012	(Smith et al., 2012)
Lake Hoare (77° 38' 00" S 162° 52' 00" E)	*Plectus antarcticus*	1998	(Powers et al., 1998)
	Scottnema lindsayae	1998 2005	(Bamforth et al., 2005; Powers et al., 1998)
	Eudorylaimus antarcticus	2005	(Bamforth et al., 2005)
Canada Glacier (77° 37' 00" S 162° 59' 00" E)	*Plectus spp.*	1993	(Schwarz et al., 1993)
Lake Fryxwell (77° 37' 00" S 163° 11' 00" E)	*Plectus antarcticus*	1989 2005	(Bamforth et al., 2005; Wharton & Brown, 1989)
	Eudorylaimus antarcticus	1989 2005	(Bamforth et al., 2005; Wharton & Brown, 1989)
	Scottnema lindsayae	2005	(Bamforth et al., 2005)
Cape Royds (77° 35' 00" S 166° 10' 00" E)	*Plectus antarcticus*	1989	(Wharton & Brown, 1989)
	Plectus frigophilus	1989	(Wharton & Brown, 1989)
	Panagrolaimus davidi	1989 2002	(Porazinska et al., 2002; Wharton & Brown, 1989)
	Scottnema lindsayae	2002	(Porazinska et al., 2002)
Lake Canopus (77° 33' 00" S 161° 31' 00" E)	*Plectus antarcticus*	1989	(Wharton & Brown, 1989)
Lake Vanda (77° 31' 47" S 161° 34' 32" E)	*Eudorylaimus antarcticus*	1989	(Wharton & Brown, 1989)
	Plectus antarcticus	1989	(Wharton & Brown, 1989)
	Plectus frigophilus	1989	(Wharton & Brown, 1989)
	Monhystera villosa	1989	(Wharton & Brown, 1989)
	Scottnema lindsayae	2005	(Bamforth et al., 2005)
Cape Crozier (77° 31' 00" S	*Scottnema lindsayae*	2002	(Porazinska et al., 2002)

169° 24' 00" E)	*Eudorylaimus antarcticus*	2002	(Porazinska et al., 2002)
	Panagrolaimus davidi	2002	(Porazinska et al., 2002)
	Plectus antarcticus	2002	(Porazinska et al., 2002)
Ross Island (77° 30' 00" S 168° 11' 00" E)	*Eudorylaimus antarcticus,*	1989	(Wharton & Brown, 1989)
	Plectus antarcticus	1989	(Wharton & Brown, 1989)
Bull Pass (77° 28' 00" S 163° 11' 00" E)	*Plectus antarcticus*	2005	(Bamforth et al., 2005)
	Scottnema lindsayae	2008	(Poage et al., 2008)
	Eudorylaimus antarcticus	2008	(Poage et al., 2008)
McKelvey Valley (77° 26' 00" S 161° 33' 00" E)	*Scottnema lindsayae*	2005	(Bamforth et al., 2005)
	Eudorylaimus antarcticus	2005	(Bamforth et al., 2005)
Victoria Valley (77° 23' 00" S 162° 00' 00" E)	*Scottnema lindsayae*	2005	(Bamforth et al., 2005)
Cape Bird (77° 10' 00" S 166° 41' 00" E)	*Eudorylaimus antarcticus,*	1989	(Wharton & Brown, 1989)
	Plectus antarcticus	1989	(Wharton & Brown, 1989)
	Plectus frigophilus	1989	(Wharton & Brown, 1989)
	Panagrolaimus davidi	1989 2002	(Porazinska et al., 2002; Wharton & Brown, 1989)
Cape Hallet (72° 19' 00" S 170° 16' 00" E)	*Eudorylaimus antarcticus*	2013	(Raymond, Wharton, & Marshall, 2013)
	Scottnema lindsayae	2013	(Raymond et al., 2013)
	Panagrolaimus davidi	2013	(Raymond et al., 2013)
	Plectus antarcticus	2013	(Raymond et al., 2013)

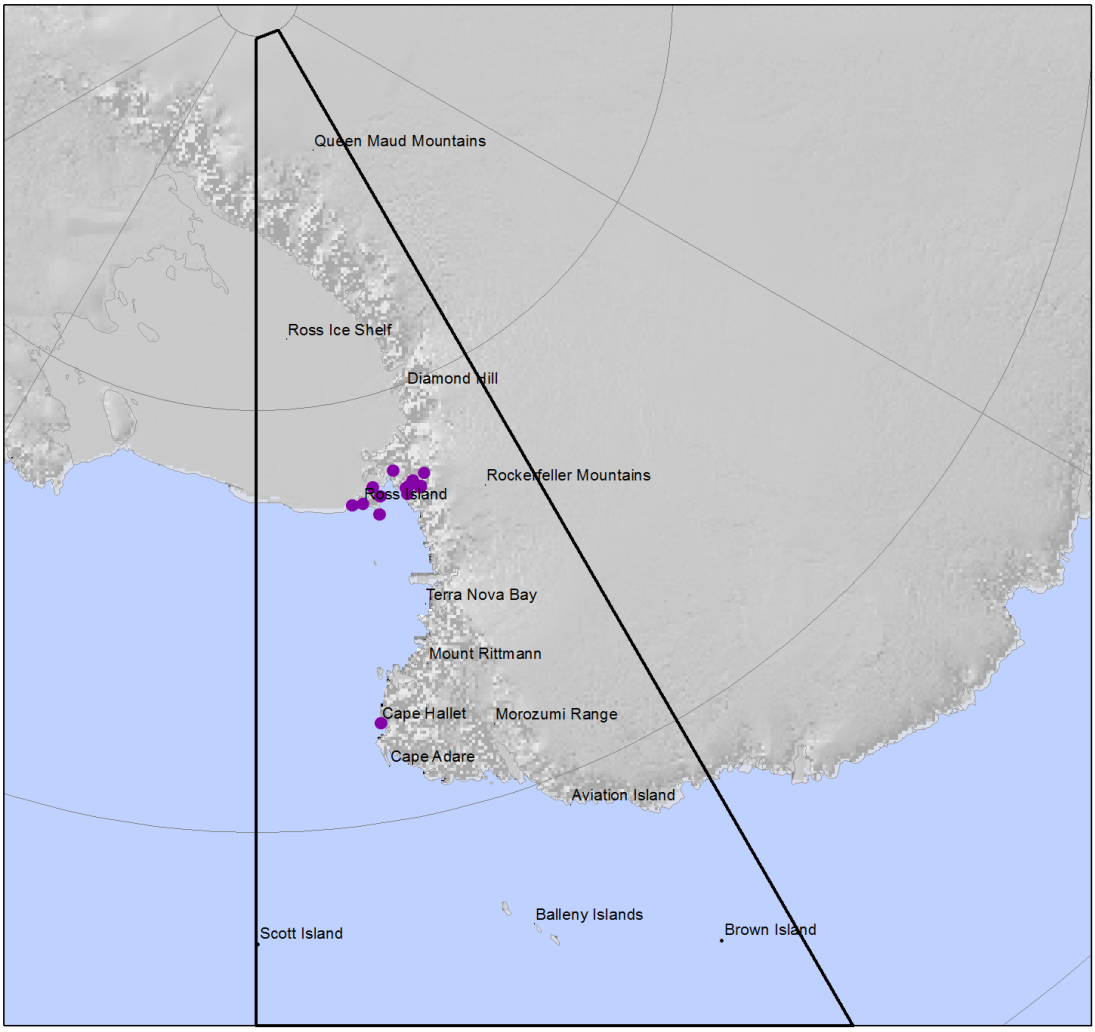

Figure 12. Map of nematode colonies in the Ross Sea region

MICROARTHROPODS (MITES & SPRINGTAILS)

The microarthropods, mites and springtails, are the largest terrestrial organisms in Antarctica and dominate the terrestrial ecosystem (Waterhouse, 2001). Although widely separated taxonomically, mites and springtails are similar in size and often co-occupy functional group (Sinclair & Stevens, 2006). They have a patchy distribution and are confined to ice free areas with rich organic material (A. McGaughran, Hogg, & Convey, 2011; Velasco-Castrillón, Gibson, & Stevens, 2014). They are generally found in the soil, vegetation, or the underside of rocks (Caruso, Borghini, Bucci, Colacevich, & Bargagli, 2007; A. McGaughran et al., 2011). Springtails have adapted to survive low temperatures by utilizing a freeze-avoidance strategy, by depression of their freezing point to below the temperature of the environment (Sinclair & Sjursen, 2001a). They are living at the limit of their biological capabilities and therefore can be used as bioindicators in studies on invasive species and climate change (Sinclair & Stevens, 2006; Slabber, Roger Worland, Petter Leinaas, & Chown, 2007). 12 species of mites (Table 12) (Figure 13), and 10 species of springtails (Table 13) (Figure 14) were identified in the Ross Sea region.

Table 12. Locations of mite colonies in the Ross Sea region

Location	Species	Year	Reference
Beardmore Glacier (83° 45' 00" S 171° 00' 00" E)	*Nanorchestes antarcticus*	1965	(Gressitt & Wise, 1965)
	Stereotydeus shoupi	2006 2014	(C. Colesie et al., 2014; Mark I. Stevens & Hogg, 2006)
	Protereunetes maudae	2014	(C. Colesie et al., 2014)
	Tydeus setsukoae	2014	(C. Colesie et al., 2014)
Diamond Hill (79° 52' 00" S 159° 09' 00" E)	*Stereotydeus shoupi*	2014	(C. Colesie et al., 2014)
Miers Valley (78° 06' 00" S 164° 00' 00" E)	*Stereotydeus mollis*	2002 2006 2008	(Angela McGaughran, Hogg, & Stevens, 2008; Mark I. Stevens & Hogg, 2002, 2006)
Garwood Valley (78° 02' 00" S 164° 10' 00" E)	*Stereotydeus mollis*	2002	(Mark I. Stevens & Hogg, 2002)
Bratina Island (78° 01' 00" S	*Stereotydeus mollis*	2002	(Mark I. Stevens & Hogg, 2002)

165° 32' 00" E)			
Keble Valley (78° 00' 00" S 164° 10' 00" E)	*Stereotydeus mollis*	2001 2002	(Sinclair & Sjursen, 2001b; Sjursen & Sinclair, 2002)
	Nanorchestes antarcticus	2001	(Sinclair & Sjursen, 2001b)
Observation Hill (77° 51' 00" S 166° 40' 00" E)	*Stereotydeus mollis*	2002	(Mark I. Stevens & Hogg, 2002)
Hut Point Peninsula (77° 51' 00" S 166° 38' 00" E)	*Stereotydeus mollis*	2006	(Mark I. Stevens & Hogg, 2006)
Cape Evans (77° 38' 00" S 166° 24' 00" E)	*Stereotydeus mollis*	2002	(Mark I. Stevens & Hogg, 2002, 2006)
Taylor Valley (77° 37' 00" S 163° 00' 00" E)	*Stereotydeus mollis*	2002 2006 2008 2014	(C. Colesie et al., 2014; Angela McGaughran et al., 2008; Mark I. Stevens & Hogg, 2002, 2006)
Cape Royds (77° 35' 00" S 166° 10' 00" E)	*Stereotydeus mollis*	2002 2006	(Mark I. Stevens & Hogg, 2002, 2006)
Cape Barne (77° 35' 00" S 166° 14' 00" E)	*Stereotydeus mollis*	2002	(Mark I. Stevens & Hogg, 2002)
Cape Crozier (77° 31' 00" S 169° 24' 00" E)	*Stereotydeus mollis*	2002	(Mark I. Stevens & Hogg, 2002)
Ross Island (77° 30' 00" S 168° 11' 00" E)	*Stereotydeus mollis*	2008	(Angela McGaughran et al., 2008)
Marble Point (77° 26' 00" S 163° 50' 00" E)	*Stereotydeus mollis*	2002 2006 2008	(Angela McGaughran et al., 2008; Mark I. Stevens & Hogg, 2002, 2006)
	Nanorchestes antarcticus	2014	(C. Colesie et al., 2014)
Victoria Valley (77° 23' 00" S 162° 00' 00" E)	*Stereotydeus mollis*	2008	(Angela McGaughran et al., 2008)
Cape Bird (77° 10' 00" S 166° 41' 00" E)	*Nanorchestes antarcticus*	2002	(Sinclair, 2002)
	Stereotydeus mollis	2002 2006	(Sinclair, 2002; Mark I. Stevens & Hogg, 2002, 2006)
Mt England (77° 03' 00" S 162° 27' 00" E)	*Stereotydeus mollis*	2002 2006	(Mark I. Stevens & Hogg, 2002, 2006)
Granite Harbour (77° 00' 00" S	*Stereotydeus mollis*	2002 2006 2008	(C. Colesie et al., 2014; Angela McGaughran et al., 2008; Mark I. Stevens &

162° 35' 00" E)		2014	Hogg, 2002, 2006)
Beaufort Island (76° 56' 00" S 166° 56' 00" E)	*Stereotydeus mollis*	2002 2006 2008	(Angela McGaughran et al., 2008; Mark I. Stevens & Hogg, 2002, 2006)
Terra Nova Bay (74° 50' 00" S 164° 30' 00" E)	*Eupodes wisei*	2007 2014	(Caruso & Bargagli, 2007; C. Colesie et al., 2014)
	Stereotydeus belli	2007	(Caruso & Bargagli, 2007; Caruso et al., 2007)
	Stereotydeus mollis	2007 2014	(Caruso & Bargagli, 2007; C. Colesie et al., 2014)
	Nanorchestes antarcticus	2007	(Caruso & Bargagli, 2007)
Edmonson Point (74° 20' 00" S 165° 08' 00" E)	*Eupodes wisei*	2007	(Caruso & Bargagli, 2007)
	Stereotydeus belli	2007	(Caruso & Bargagli, 2007; Caruso et al., 2007)
Kay Island (74° 04' 00" S 165° 19' 00" E)	*Maudheimia petronia*	2007	(Caruso & Bargagli, 2007)
	Eupodes wisei	2007	(Caruso & Bargagli, 2007)
	Stereotydeus belli	2007	(Caruso & Bargagli, 2007; Caruso et al., 2007)
	Coccorhagidia gressitti	2007	(Caruso & Bargagli, 2007)
Apostrophe Island (73° 31' 00" S 167° 26' 00" E)	*Maudheimia petronia*	2007	(Caruso & Bargagli, 2007)
	Eupodes wisei	2007	(Caruso & Bargagli, 2007)
	Stereotydeus belli	2007	(Caruso & Bargagli, 2007; Caruso et al., 2007)
	Nanorchestes antarcticus	2007	(Caruso & Bargagli, 2007)
Crater Cirque (72° 19' 00" S 170° 16' 00" E)	*Maudheimia petronia*	2007	(Caruso & Bargagli, 2007)
	Eupodes wisei	2007	(Caruso & Bargagli, 2007)
	Stereotydeus belli	2007	(Caruso & Bargagli, 2007; Caruso et al., 2007)
	Coccorhagidia gressitti	2007	(Caruso & Bargagli, 2007)
Cape Hallet (72° 19' 00" S 170° 16' 00" E)	*Stereotydeus belli*	2006 2014	(C. Colesie et al., 2014; Sinclair et al., 2006; Mark I. Stevens & Hogg, 2006)
	Maudheimia petronia	2006	(Sinclair et al., 2006)
	Coccorhagidia gressitti	2006 2014	(C. Colesie et al., 2014; Sinclair et al., 2006)
	Eupodes wisei	2006 2014	(C. Colesie et al., 2014; Sinclair et al., 2006)
	Nanorchestes antarcticus	2006 2014	(C. Colesie et al., 2014; Sinclair et al., 2006)
	Stereotydeus punctatus	2006 2014	(C. Colesie et al., 2014; Sinclair et al., 2006)
	Tydeus setsukoae	2006 2014	(C. Colesie et al., 2014; Sinclair et al., 2006)
	Tydeus wadei	2006 2014	(C. Colesie et al., 2014; Sinclair et al., 2006)

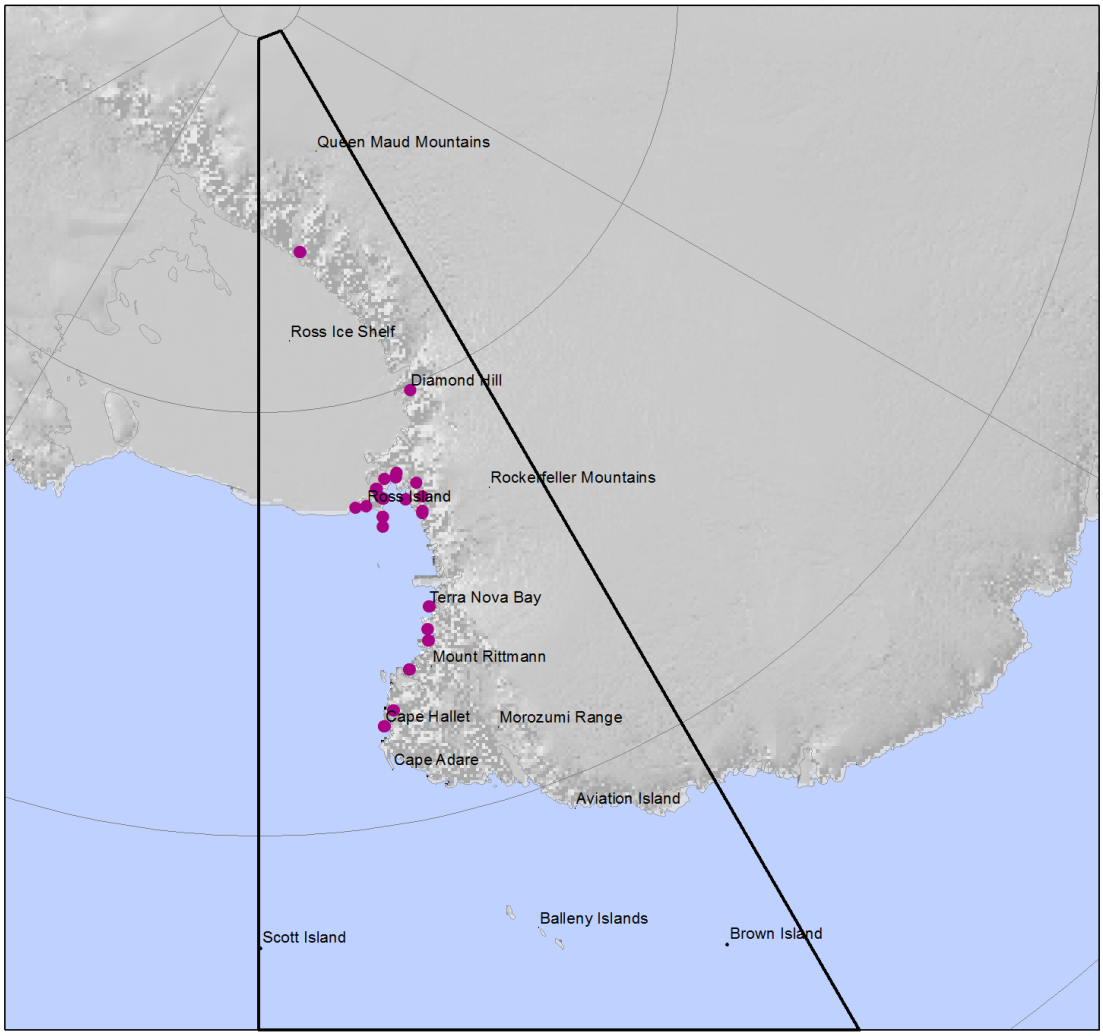

Figure 13. Map of mite colonies in the Ross Sea region

Table 13. Locations of springtail colonies in the Ross Sea region

Location	Species	Year	Reference
Beardmore Glacier (83° 45' 00" S 171° 00' 00" E)	*Biscoia sudpolaris*	1965 2006 2014	(C. Colesie et al., 2014; Gressitt & Wise, 1965; Mark I. Stevens & Hogg, 2006)
	Anurophorus subpolaris	1965 2014	(C. Colesie et al., 2014; Gressitt & Wise, 1965)
	Tullbergia mediantarctica	2014	(C. Colesie et al., 2014)
Lake Penny (78° 16' 00" S 163° 12' 00" E)	*Gomphiocephalus hodgsoni*	2006 2008	(Angela McGaughran et al., 2008; Mark I. Stevens & Hogg, 2006)
Miers Valley (78° 06' 00" S 164° 00' 00" E)	*Gomphiocephalus hodgsoni*	2002 2006 2008	(Angela McGaughran et al., 2008; Mark I. Stevens & Hogg, 2002, 2006)
Garwood Valley (78° 02' 00" S	*Gomphiocephalus hodgsoni*	2002 2006 2008	(A. McGaughran et al., 2011; Angela McGaughran et al., 2008; Mark I. Stevens & Hogg,

164° 10' 00" E)		2011	2002, 2006)
Bratina Island (78° 01' 00" S 165° 32' 00" E)	*Gomphiocephalus hodgsoni*	2002	(Mark I. Stevens & Hogg, 2002)
Keble Valley (78° 00' 00" S 164° 10' 00" E)	*Gomphiocephalus hodgsoni*	2001	(Sinclair & Sjursen, 2001b)
Cape Evans (77° 38' 00" S 166° 24' 00" E)	*Gomphiocephalus hodgsoni*	2002	(Mark I. Stevens & Hogg, 2002, 2006)
Taylor Valley (77° 37' 00" S 163° 00' 00" E)	*Gomphiocephalus hodgsoni*	2002 2003 2006 2008 2014	(C. Colesie et al., 2014; Angela McGaughran et al., 2008; Nolan, Hogg, Stevens, & Haase, 2006; Mark I. Stevens & Hogg, 2002, 2003, 2006)
Cape Royds (77° 35' 00" S 166° 10' 00" E)	*Gomphiocephalus hodgsoni*	2002 2006	(Mark I. Stevens & Hogg, 2002, 2006)
Cape Crozier (77° 31' 00" S 169° 24' 00" E)	*Gomphiocephalus hodgsoni*	2002 2006	(Mark I. Stevens & Hogg, 2002, 2006)
Wright Valley (77° 31' 00" S 161° 50' 00" E)	*Gomphiocephalus hodgsoni*	2008	(Angela McGaughran et al., 2008)
Ross Island (77° 30' 00" S 168° 11' 00" E)	*Gomphiocephalus hodgsoni*	2008	(Angela McGaughran et al., 2008)
Marble Point (77° 26' 00" S 163° 50' 00" E)	*Gomphiocephalus hodgsoni*	2002 2006 2008	(Angela McGaughran et al., 2008; Mark I. Stevens & Hogg, 2002, 2006)
Victoria Valley (77° 23' 00" S 162° 00' 00" E)	*Gomphiocephalus hodgsoni*	2008	(Angela McGaughran et al., 2008)
Cape Bird (77° 10' 00" S 166° 41' 00" E)	*Gomphiocephalus hodgsoni*	2002 2003 2006 2009	(A. McGaughran, Redding, Stevens, & Convey, 2009; Sinclair, 2002; Mark I. Stevens & Hogg, 2002, 2003, 2006)
Mt England (77° 03' 00" S 162° 27' 00" E)	*Gomphiocephalus hodgsoni*	2002	(Mark I. Stevens & Hogg, 2002)
	Neocryptopgus nivicolus	2002	(Mark I. Stevens & Hogg, 2002)
Granite Harbour (77° 00' 00" S 162° 35' 00" E)	*Gomphiocephalus hodgsoni*	1996 2002 2003 2006 2008 2014	(C. Colesie et al., 2014; Davidson & Broady, 1996; Angela McGaughran et al., 2008; Mark I. Stevens & Hogg, 2002, 2003, 2006)
	Neocryptopgus nivicolus	2002 2014	(C. Colesie et al., 2014; Mark I. Stevens & Hogg, 2002)

Beaufort Island (76° 56' 00" S 166° 56' 00" E)	*Gomphiocephalus hodgsoni*	2002 2006 2008	(Angela McGaughran et al., 2008; Mark I. Stevens & Hogg, 2002, 2006)
Terra Nova Bay (74° 50' 00" S 164° 30' 00" E)	*Gressittacantha terranova*	2007 2014	(Caruso & Bargagli, 2007; Caruso et al., 2007; C. Colesie et al., 2014)
Edmonson Point (74° 20' 00" S 165° 08' 00" E)	*Gressittacantha terranova*	2007	(Caruso & Bargagli, 2007; Caruso et al., 2007)
Kay Island (74° 04' 00" S 165° 19' 00" E)	*Friesea grisea*	2007 2010	(Caruso & Bargagli, 2007; Torricelli et al., 2010)
	Gressittacantha terranova	2007	(Caruso & Bargagli, 2007; Caruso et al., 2007)
Apostrophe Island (73° 31' 00" S 167° 26' 00" E)	*Gressittacantha terranova*	2007	(Caruso & Bargagli, 2007; Caruso et al., 2007)
Crater Cirque (72° 19' 00" S 170° 16' 00" E)	*Desoria klovstadi*	2006 2007	(Caruso & Bargagli, 2007; Mark I. Stevens et al., 2006)
	Friesea grisea	2007	(Caruso & Bargagli, 2007)
	Gressittacantha terranova	2007	(Caruso & Bargagli, 2007; Caruso et al., 2007)
Cape Hallet (72° 19' 00" S 170° 16' 00" E)	*Cryptopygus cisantarcticus*	2006 2014	(C. Colesie et al., 2014; Sinclair et al., 2006)
	Isotoma klovstadi	2006 2014	(C. Colesie et al., 2014; Sinclair et al., 2006)
	Friesea grisea	2006 2014	(C. Colesie et al., 2014; Sinclair et al., 2006)
Cape Adare (71° 17' 00" S 170° 14' 00" E)	*Desoria klovstadi*	2006	(Mark I. Stevens et al., 2006)

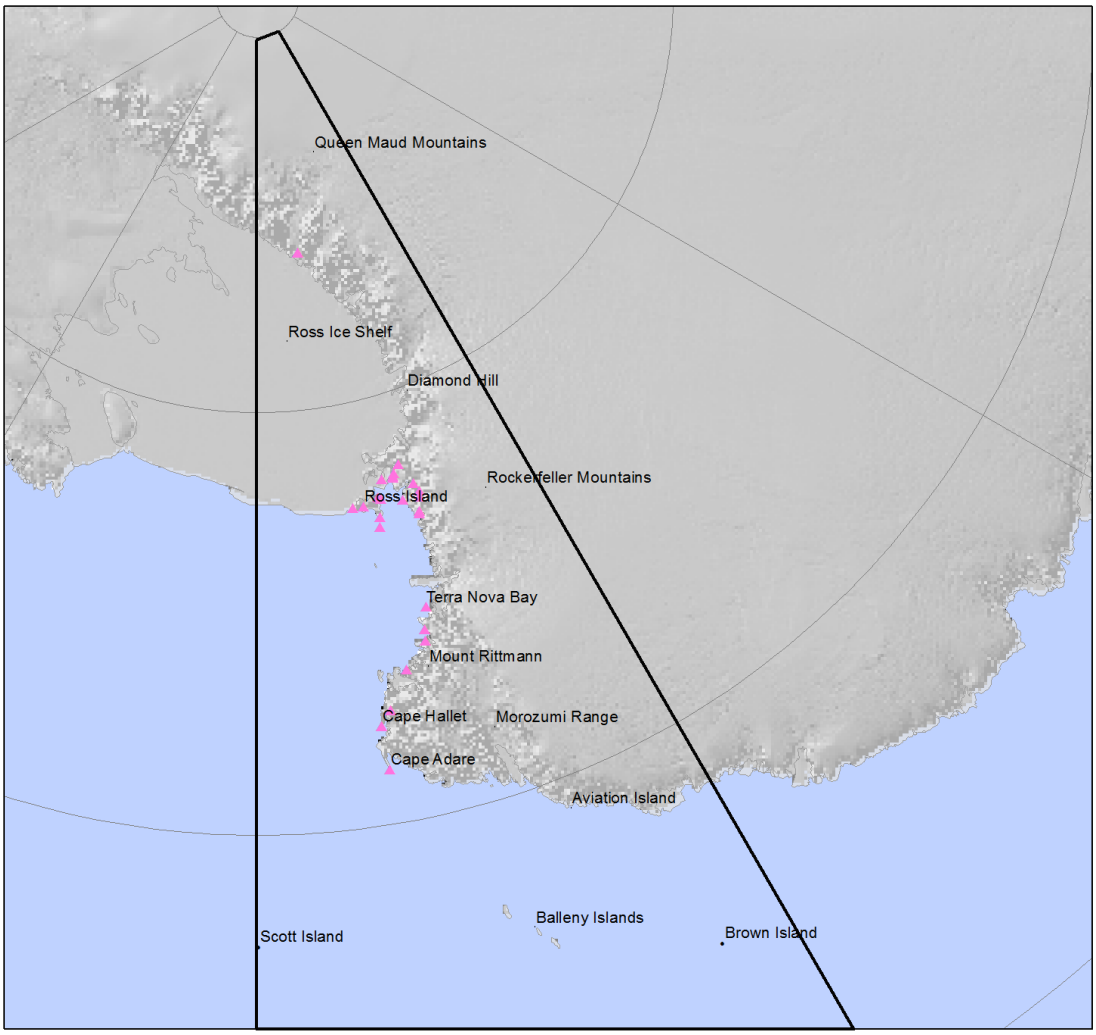

Figure 14. Map of springtail colonies in the Ross Sea region

CRUSTACEA (COPEPOD)

The geographic isolation of Antarctic freshwater lakes has long been thought to be a barrier to colonisation by copepods (Karanovic, Gibson, Hawes, Andersen, & Stevens, 2014). Repeated sampling of the McMurdo Dry Valleys had failed to find any crustaceans until 2004, when Roberts, Priscu, Wolf, Lyons, and Laybourn-Parry (2004) reported the occurrence of juvenile copepods in Lake Joyce. Then in 2012, Svensson et al. found a singular sub-adult crustacean copepod belonging to the genus *Boeckella* in Lake Hoare, another nearby Dry Valley lake (Table 14) (Figure 15) (Svensson et al., 2012). In 2014, adult copepods were discovered. Under 5 metres of ice, a large, active population of genetically distinct copepods was found in Lake Joyce and named *Diacyclops joycei* (Table 14) (Figure 15) (Karanovic et al., 2014). Copepods are common in temperate and tropical waters but the harsh conditions of the Antarctic freshwater lakes places severe constraints on the ability of these environments to support crustacea (Karanovic et al., 2014).

Table 14 . Locations of copepod colonies in the Ross Sea region

Location	**Species**	**Year**	**Reference**
Lake Joyce (77° 43' 00" S 161° 37' 00" E)	*Diacyclops joycei*	2004 2014	(Karanovic et al., 2014; Roberts et al., 2004)
Lake Hoare (77° 38' 00" S 162° 52' 00" E)	*Boeckella sp.*	2012	(Svensson et al., 2012)

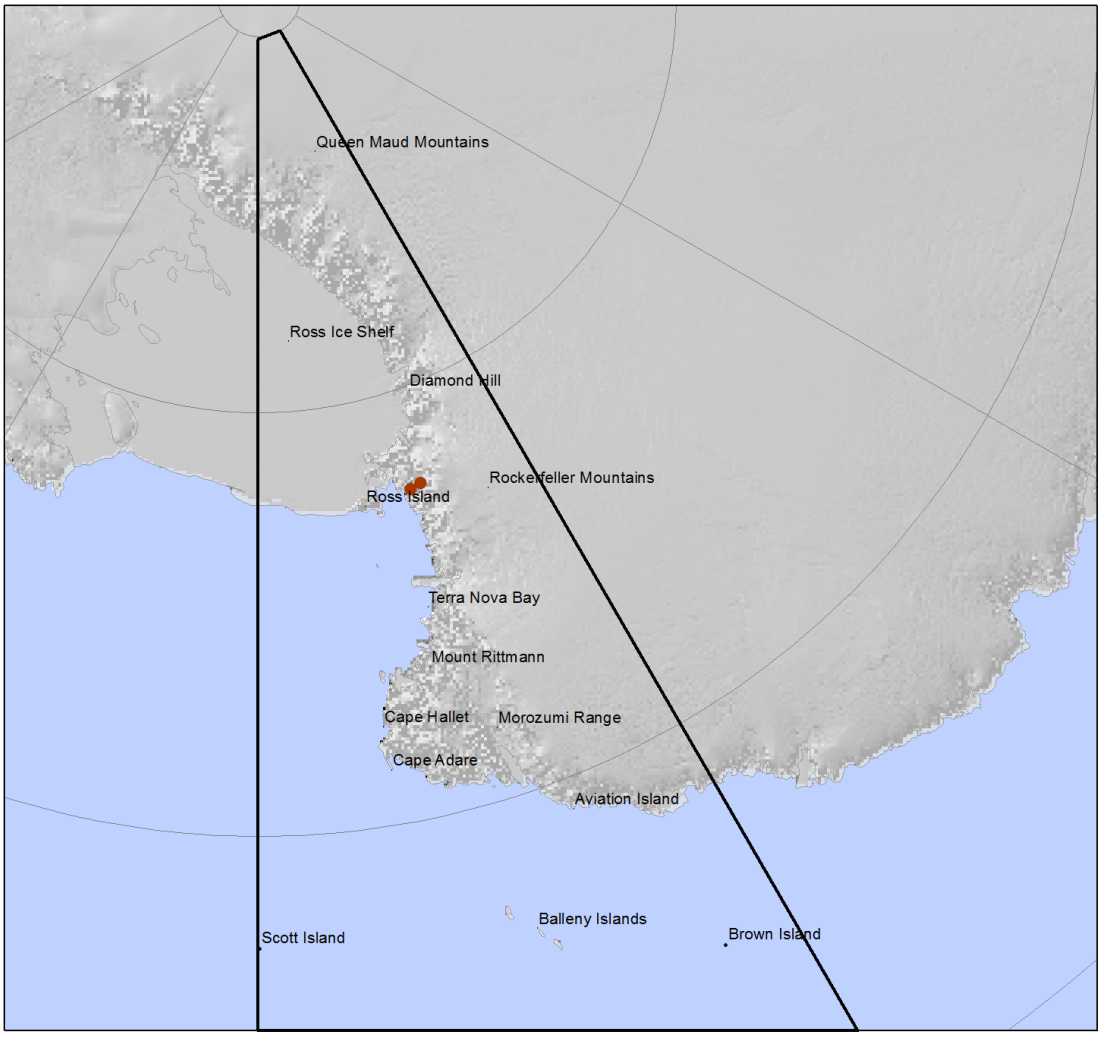

Figure 15. Map of the copepod colonies in the Ross Sea region

BIRDS (PENGUINS, PETRELS & SKUA)

Sea birds are not completely marine, they are dependant on the terrestrial environment as a breeding ground. There are many breeding colonies of penguins, petrels and skua in the Ross Sea region. They play a significant role in the ecosytem in terms of predation on krill and fish, as well as nutrient enhancement on land, creating favourable environments for other wildlife colonies such as microorganisms and plants. The Ross Sea region is a important habitat for sea birds such as Emperor and Adelie penguins, representing one third of the total world population of these species (Table 15) (Figure 16) (Waterhouse, 2001). The Chinstrap penguin is also found in the Ross Sea region, but only on the Balleny Islands (Table 15) (Figure 16). Snow, Antarctic, Wilson's storm and Pintado petrels, Antarctic fulmars and Antarctic prions are also found in the Ross Sea region (Table 16) (Figure 17), as well as South polar and southern skuas (Table 17) (Figure 18).

Table 15. Locations of penguin colonies in the Ross Sea region

Location	**Species**	**Year**	**Reference**
Taylor Glacier (77° 37' 00" S 163° 00' 00" E)	*Aptenodytes fosteri (Emperor)*	1954 1997 2004 2014	(Kirkwood & Robertson, 1997; Robertson, Wienecke, Emmerson, & Fraser, 2014; Wienecke, 2010; Wienecke, Kirkwood, & Robertson, 2004)
Cape Royds (77° 35' 00" S 166° 10' 00" E)	*Pygoscelis adeliae (Adelie)*	1980 1990 2003 2006 2010 2012	(David G. Ainley et al., 2003; David G. Ainley, Ballard, & Dugger, 2006; Ballard et al., 2010; International Council for Bird, 1982; Nie, Liu, Sun, & Emslie, 2012; Taylor, Wilson, & Thomas, 1990)
Cape Crozier (77° 31' 00" S 169° 24' 00" E)	*Aptenodytes fosteri (Emperor)*	1902 1982 1993 2001 2008	(Barber-Meyer, Kooyman, & Ponganis, 2008; Jennifer M. Burns & Kooyman, 2001; International Council for Bird, 1982; Kooyman, 1993; Wienecke, 2010)

	Pygoscelis adeliae (Adelie)	1966 2003 2006 2010 2012 2014	(David G. Ainley et al., 2003; David G. Ainley et al., 2006; Ballard et al., 2010; International Council for Bird, 1982; Lescroël, Ballard, Grémillet, Authier, & Ainley, 2014; Nie et al., 2012)
Bartlett Inlet (77° 13' 00" S 156° 40' 00" E)	*Aptenodytes fosteri (Emperor)*	2001	(Waterhouse, 2001)
Cape Bird (77° 10' 00" S 166° 41' 00" E)	*Pygoscelis adeliae (Adelie)*	1964 1995 1997 2003 2012	(David G. Ainley et al., 2003; Court et al., 1997; Hunter, Miller, & Davis, 1995; International Council for Bird, 1982; Nie et al., 2012)
Beaufort Island (76° 56' 00" S 166° 56' 00" E)	*Aptenodytes fosteri (Emperor)*	1962 1982 1993 2001 2008	(Barber-Meyer et al., 2008; Jennifer M. Burns & Kooyman, 2001; International Council for Bird, 1982; Kooyman, 1993; Wienecke, 2010)
	Pygoscelis adeliae (Adelie)	1982 1990 2003 2012 2013	(David G. Ainley et al., 2003; International Council for Bird, 1982; LaRue et al., 2013; Nie et al., 2012; Taylor et al., 1990)
Franklin Island (76° 05' 00" S 168° 19' 00" E)	*Aptenodytes fosteri (Emperor)*	1964 1982 1993 2001 2008	(Barber-Meyer et al., 2008; Jennifer M. Burns & Kooyman, 2001; International Council for Bird, 1982; Kooyman, 1993; Wienecke, 2010)
	Pygoscelis adeliae (Adelie)	1990	(Taylor et al., 1990)
Wood Bay (74° 13' 00" S 165° 30' 00" E)	*Pygoscelis adeliae (Adelie)*	1981	(International Council for Bird, 1982)
Terra Nova Bay (74° 50' 00" S 164° 30' 00" E)	*Pygoscelis adeliae (Adelie)*	1982	(International Council for Bird, 1982)
Inexpressible Island (74° 54' 00" S 163° 39' 00" E)	*Pygoscelis adeliae (Adelie)*	1982 2010	(International Council for Bird, 1982; Lorenzini et al., 2010)
Northern	*Pygoscelis adeliae*	2001	(Waterhouse, 2001)

Foothills (74° 44' 00" S 163° 55' 00" E)	*(Adelie)*		
North Adelie Cove (74° 44' 00" S 164° 07' 00" E)	*Pygoscelis adeliae (Adelie)*	2010	(Lorenzini et al., 2010)
Icarus Camp 74° 42' 00" S 164° 07' 00" E	*Pygoscelis adeliae (Adelie)*	2010	(Lorenzini et al., 2010)
Mario Zucchelli Staion (74° 41' 00" S 164° 07' 00" E)	*Pygoscelis adeliae (Adelie)*	2010	(Lorenzini et al., 2010)
Cape Washington (74° 39' 00" S 165° 25' 00" E)	*Aptenodytes fosteri (Emperor)*	1965 1982 1993 2001 2008	(Barber-Meyer et al., 2008; Jennifer M. Burns & Kooyman, 2001; International Council for Bird, 1982; Kooyman, 1993; Wienecke, 2010)
Edmonson Point (74° 20' 00" S 165° 08' 00" E)	*Pygoscelis adeliae (Adelie)*	2007 2009 2010	(Ballerini, Tavecchia, Olmastroni, Pezzo, & Focardi, 2009; Lorenzini et al., 2010; Nesti et al., 2010; Pezzo, Olmastroni, Volpi, & Focardi, 2007)
Coulman Island (73° 28' 00" S 169° 45' 00" E)	*Aptenodytes fosteri (Emperor)*	1958 1982 1993 2001 2008	(Barber-Meyer et al., 2008; Jennifer M. Burns & Kooyman, 2001; International Council for Bird, 1982; Kooyman, 1993; Wienecke, 2010)
	Pygoscelis adeliae (Adelie)	1963	(International Council for Bird, 1982)
Mandible Cirque (73° 07' 00" S 169° 15' 00" E)	*Pygoscelis adeliae (Adelie)*	2001	(Waterhouse, 2001)
Cape Phillips (73° 04' 00" S 166° 36' 00" E)	*Pygoscelis adeliae (Adelie)*	2001	(Waterhouse, 2001)
Cape Wheatstone (72° 37' 00" S 170° 13' 00" E)	*Pygoscelis adeliae (Adelie)*	1964 2001	(Roeder et al., 2001)
Cotter Cifffs (72° 28' 00" S 170° 18' 00" E)	*Pygoscelis adeliae (Adelie)*	1981 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Cape Hallet (72° 19' 00" S 170° 16' 00" E)	*Pygoscelis adeliae (Adelie)*	1967 1990 2011	(International Council for Bird, 1982; Lyver et al., 2011; Taylor et al., 1990)
Cape Roget	*Aptenodytes fosteri*	1964	(Barber-Meyer et al.,

(71° 59' 00" S 170° 37' 00" E)	*(Emperor)*	1982 1993 2001 2008	2008; Jennifer M. Burns & Kooyman, 2001; International Council for Bird, 1982; Kooyman, 1993; Wienecke, 2010)
Foyn Island (71° 56' 00" S 171° 04' 00" E)	*Pygoscelis adeliae (Adelie)*	1964 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Possession Island (71° 52' 00" S 171° 12' 00" E)	*Pygoscelis adeliae (Adelie)*	1964 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Duke of York Island (71° 38' 00" S 170° 04' 00" E)	*Pygoscelis adeliae (Adelie)*	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Downshire Cliffs (71° 37' 00" S 170° 36' 00" E)	*Pygoscelis adeliae (Adelie)*	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Cape Adare (71° 17' 00" S 170° 14' 00" E)	*Pygoscelis adeliae (Adelie)*	1982 1990	(International Council for Bird, 1982; Taylor et al., 1990)
Sentry Rocks (70° 45' 00" S 167° 24' 00" E)	*Pygoscelis adeliae (Adelie)*	2001	(Waterhouse, 2001)
Unger Island (70° 41' 00" S 166° 55' 00" E)	*Pygoscelis adeliae (Adelie)*	2001	(Waterhouse, 2001)
Davis Peninsula (70° 38' 00" S 166° 16' 00" E)	*Pygoscelis adeliae (Adelie)*	1973 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Nella island (70° 37' 00" S 166° 04' 00" E)	*Pygoscelis adeliae (Adelie)*	2001	(Waterhouse, 2001)
Aviation Island (69° 16' 00" S 158° 47' 00" E)	*Pygoscelis adeliae (Adelie)*	1961 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Sturge Island (67° 28' 00" S 164° 38' 00" E)	*Pygoscelis adeliae (Adelie)*	1973 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Sabrina Island (66° 57' 00" S 163° 17' 00" E)	*Pygoscelis adeliae (Adelie)*	1978 2001	(International Council for Bird, 1982; Waterhouse, 2001)
	Pygoscelis antarctica (Chinstrap)	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Chinstrap Islet (66° 55' 00" S 163° 20' 00" E)	*Pygoscelis adeliae (Adelie)*	1978 2001	(International Council for Bird, 1982; Waterhouse, 2001)
	Pygoscelis antarctica	1993	(Woehler, Poncet, &

	(Chinstrap)		International Council of Scientific Unions. Scientific Committee on Antarctic, 1993)
Cape Cornish (66° 43' 00" S 163° 05' 00" E)	*Pygoscelis adeliae (Adelie)*	1973 2001	(International Council for Bird, 1982; Waterhouse, 2001)

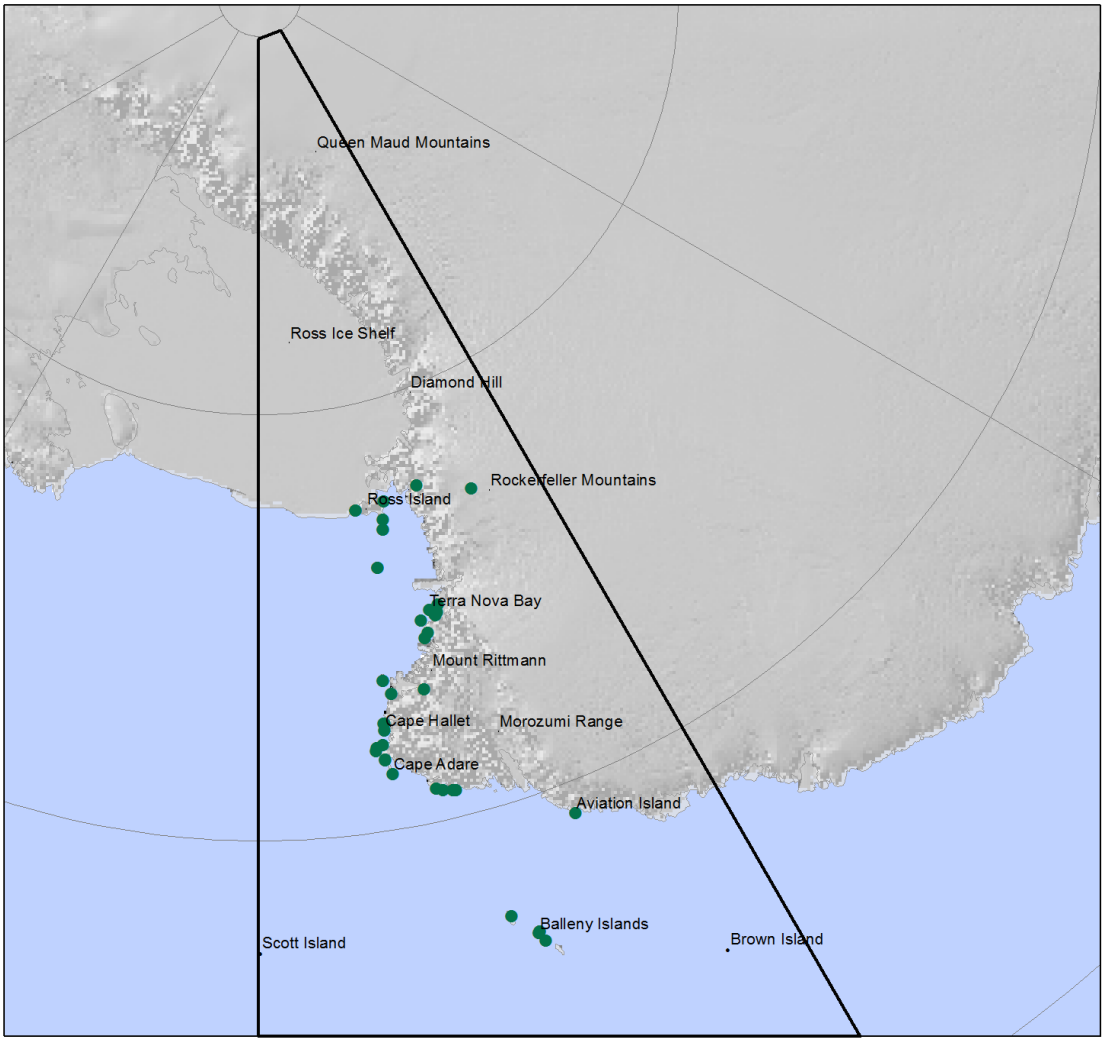

Figure 16. Map of penguin colonies in the Ross Sea region

Table 16. Locations of petrel colonies in the Ross Sea region

Location	**Species**	**Year**	**Reference**
Edward VII Peninsula (77° 40' 00" S 155° 00' 00" E)	*Daption capense (Pintado petrel)*	1989	(P. A. Broady et al., 1989)
Rockerfeller Mountains (77° 00' 00" S 155° 00' 00" E)	*Pagodroma nivea (Snow petrel)*	2001	(Waterhouse, 2001)
	Thalassocia antarctica (Antarctic petrel)	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Franklin Island (76° 05' 00" S 168° 19' 00" E)	*Oceanites oceanicus (Wilson's storm petrel)*	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Crater Cirque (72° 19' 00" S 170° 16' 00" E)	*Pagodroma nivea (Snow petrel)*	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
	Oceanites oceanicus (Wilson's storm petrel)	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Morozumi Range (71° 39' 00" S 161° 55' 00" E)	*Pagodroma nivea (Snow petrel)*	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Edisto Inlet/Felsite Island (72° 20' 00" S 170° 05' 00" E)	*Pagodroma nivea (Snow petrel)*	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
	Oceanites oceanicus (Wilson's storm petrel)	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Cape Hallett (72° 19' 00" S 170° 16' 00" E)	*Pagodroma nivea (Snow petrel)*	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
	Oceanites oceanicus (Wilson's storm petrel)	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Duke of York Island (71° 38' 00" S 170° 04' 00" E)	*Pagodroma nivea (Snow petrel)*	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Robertson Bay (71° 25' 00" S 170° 00' 00" E)	*Thalassocia antarctica (Antarctic petrel)*	2001	(Waterhouse, 2001)
	Thalassocia antarctica (Antarctic petrel)	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Cape Adare (71° 17' 00" S 170° 14' 00" E)	*Pagodroma nivea (Snow petrel)*	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)

	Oceanites oceanicus (Wilson's storm petrel)	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Scott Island (67° 24' 00" S 179° 55' 00" E)	*Pagodroma nivea (Snow petrel)*	1982 1985	(International Council for Bird, 1982; Jouventin & Viot, 1985)
	Thalassocia antarctica (Antarctic petrel)	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
	Oceanites oceanicus (Wilson's storm petrel)	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
	Daption capense (Pintado petrel)	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
	Pachyptila desolata (Antarctic prion)	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Balleny Islands (66° 55' 00" S 163° 20' 00" E)	*Pagodroma nivea (Snow petrel)*	1982 1985	(International Council for Bird, 1982; Jouventin & Viot, 1985)
	Thalassocia antarctica (Antarctic petrel)	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
	Oceanites oceanicus (Wilson's storm petrel)	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
	Daption capense (Pintado petrel)	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
	Fulmaris glacialoides (Antarctic fulmar)	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)

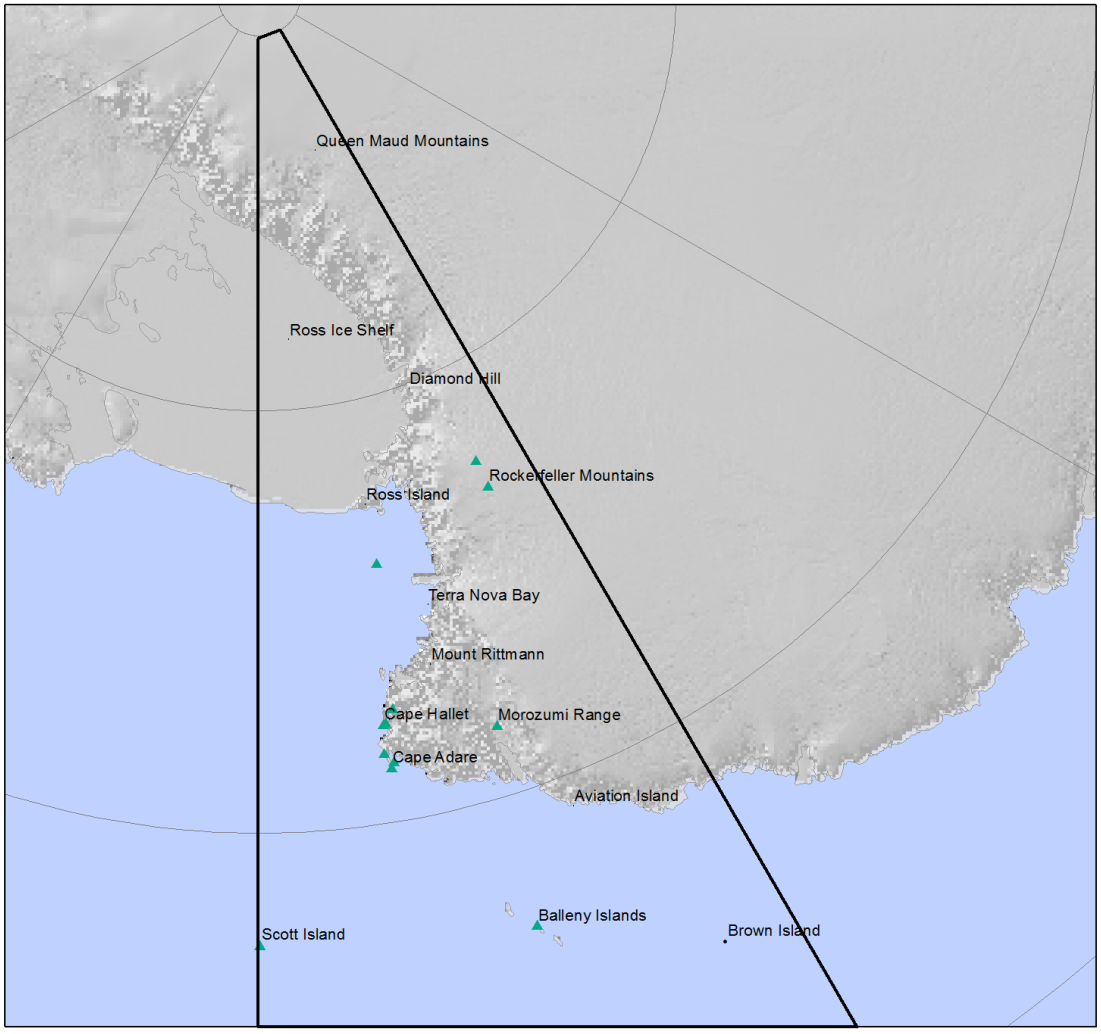

Figure 17. Map of petrel colonies in the Ross Sea region

Table 17. Locations of skua colonies in the Ross Sea region

Location	**Species**	**Year**	**Reference**
Cape Chocolate (77° 56' 00" S 164° 35' 00" E)	*Stercorarius maccromicki (South polar)*	1965-6	(International Council for Bird, 1982)
Dailey Island (77° 53' 00" S 165° 06' 00" E)	*Stercorarius maccromicki (South polar)*	1965-6	(International Council for Bird, 1982)
Hut Point (77° 51' 00" S 166° 38' 00" E)	*Stercorarius maccromicki (South polar)*	2001	(Waterhouse, 2001)
Cape Armitage (77° 51' 00" S 166° 40' 00" E)	*Stercorarius maccromicki (South polar)*	1965-6	(International Council for Bird, 1982)
Blue Glacier (77° 50' 00" S	*Stercorarius maccromicki (South*	1965-6	(International Council for Bird, 1982)

164° 10' 00" E)	*polar)*		
Cape Evans (77° 38' 00" S 166° 24' 00" E)	*Stercorarius maccromicki (South polar)*	1965-6	(International Council for Bird, 1982)
Cape Royds (77° 35' 00" S 166° 10' 00" E)	*Stercorarius maccromicki (South polar)*	1965-6 1978 2001	(International Council for Bird, 1982; Trillmich, 1978; Waterhouse, 2001)
Horseshoe Bay (77° 32' 00" S 166° 12' 00" E)	*Stercorarius maccromicki (South polar)*	1965-6	(International Council for Bird, 1982)
Cape Barne (77° 35' 00" S 166° 14' 00" E)	*Stercorarius maccromicki (South polar)*	1965-6	(International Council for Bird, 1982)
Cape Crozier (77° 31' 00" S 169° 24' 00" E)	*Stercorarius maccromicki (South polar)*	1960-70 1978 2001	(International Council for Bird, 1982; Trillmich, 1978; Waterhouse, 2001)
Rocky Point (77° 30' 00" S 166° 14' 00" E)	*Stercorarius maccromicki (South polar)*	1965-6	(International Council for Bird, 1982)
Ross Island (77° 30' 00" S 168° 11' 00" E)	*Stercorarius lonnbergi (Southern)*	2008	(Ritz et al., 2008)
Marble Point (77° 26' 00" S 163° 50' 00" E)	*Stercorarius maccromicki (South polar)*	1965-6	(International Council for Bird, 1982)
Cape Bird (77° 10' 00" S 166° 41' 00" E)	*Stercorarius maccromicki (South polar)*	1978-9 1994 1997 2001	(Court et al., 1997; International Council for Bird, 1982; Penney & Lowry, 1967; Waterhouse, 2001)
Beaufort Island (76° 56' 00" S 166° 56' 00" E)	*Stercorarius maccromicki (South polar)*	1982	(International Council for Bird, 1982)
Cape Ross (76° 44' 00" S 163° 01' 00" E)	*Stercorarius maccromicki (South polar)*	2001	(Waterhouse, 2001)
Franklin Island (76° 05' 00" S 168° 19' 00" E)	*Stercorarius maccromicki (South polar)*	1982	(International Council for Bird, 1982)
Inexpressible Island (74° 54' 00" S 163° 39' 00" E)	*Stercorarius maccromicki (South polar)*	2001	(Waterhouse, 2001)
Northern Foothills (74° 44' 00" S 163° 55' 00" E)	*Stercorarius maccromicki (South polar)*	2001	(Waterhouse, 2001)
Edmonson Point (74° 20' 00" S	*Stercorarius lonnbergi (Southern)*	2001 2008	(Ritz et al., 2008; Waterhouse, 2001)

165° 08' 00" E)			
Wood Bay (74° 13' 00" S 165° 30' 00" E)	*Stercorarius maccromicki (South polar)*	1982	(International Council for Bird, 1982)
Coulman Island (73° 28' 00" S 169° 45' 00" E)	*Stercorarius maccromicki (South polar)*	2001	(Waterhouse, 2001)
Crater Cirque (72° 19' 00" S 170° 16' 00" E)	*Stercorarius maccromicki (South polar)*	1982	(International Council for Bird, 1982)
Cape Hallet (72° 19' 00" S 170° 16' 00" E)	*Stercorarius maccromicki (South polar)*	1978 1982 2001	(International Council for Bird, 1982; Trillmich, 1978; Waterhouse, 2001)
Foyn Island (71° 56' 00" S 171° 04' 00" E)	*Stercorarius maccromicki (South polar)*	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Possession Island (71° 52' 00" S 171° 12' 00" E)	*Stercorarius maccromicki (South polar)*	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Cape Adare (71° 17' 00" S 170° 14' 00" E)	*Stercorarius maccromicki (South polar)*	1982 2001	(International Council for Bird, 1982; Waterhouse, 2001)
Scott Island (67° 24' 00" S 179° 55' 00" E)	*Stercorarius lonnbergi (Southern)*	1994	(Young, 1994)
	Stercorarius maccromicki (South polar)	1994	(Young, 1994)
Balleny Islands (66° 55' 00" S 163° 20' 00" E)	*Stercorarius lonnbergi (Southern)*	2008	(Ritz et al., 2008)
	Stercorarius maccromicki (South polar)	1982	(International Council for Bird, 1982)

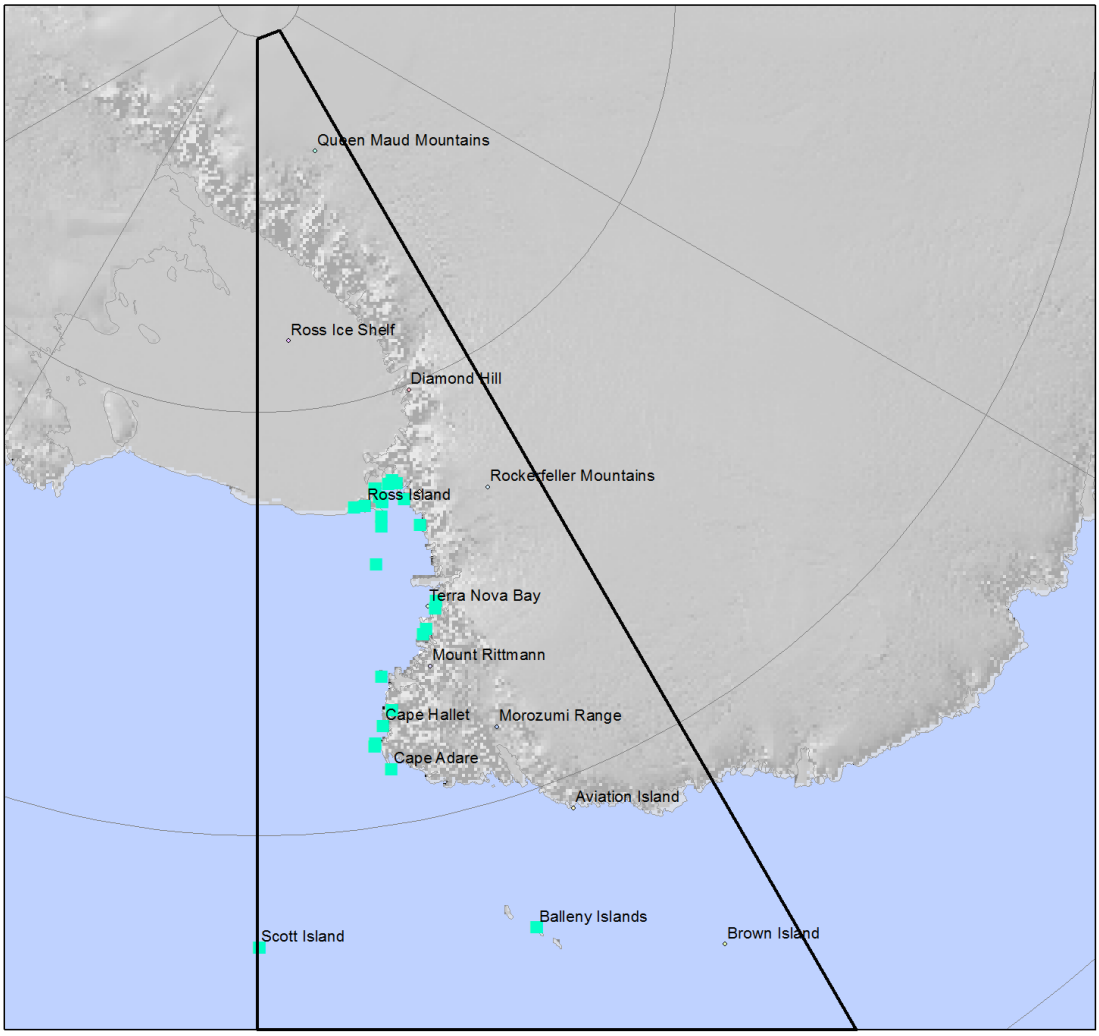

Figure 18. Map of skua colonies in the Ross Sea region

SEALS

Seals, like sea birds, are both marine and terrestrial animals, feeding at sea and returning to land to breed. They are the most common mammal in the Ross Sea region and their distribution is determined by sea ice extent (Waterhouse, 2001). There are 5 species of seal in the Ross Sea region, the Weddell, Crabeater, Ross, Leopard and Southern Elephant seals (Table 18) (Figure 19).

Table 18. Locations of seal colonies in the Ross Sea region

Location	Species	Year	Reference
Ross Ice Shelf pack-ice (81° 30' 00" S 175° 00' 00" E)	*Lobodon carcinophagus (Crabeater)*	1985 2003 2008 2012	(Ackley et al., 2003; D. G. Ainley, 1985; Davis, Stirling, Strobeck, & Coltman, 2008; Southwell et al., 2012)
	Hydruga leptonyx (Leopard)	2001 2003	(Ackley et al., 2003; Morejohn, 2001)
	Ommatophoca rossii (Ross)	2001 2008	(Davis et al., 2008; Morejohn, 2001)
Hut Point Peninsula (77° 51' 00" S 166° 38' 00" E)	*Leptochynotes weddellii (Weddell)*	2009	(David G. Ainley & Siniff, 2009)
Erebus Bay (77° 44' 00" S 166° 31' 00" E)	*Leptochynotes weddellii (Weddell)*	1987 2008	(Proffitt, Garrott, & Rotella, 2008; Testa & Siniff, 1987)
	Hydruga leptonyx (Leopard)	2009	(Rotella et al., 2009)
Turtle Rock (77° 44' 00" S 166° 46' 00" E)	*Leptochynotes weddellii (Weddell)*	1977	(Siniff, DeMaster, Hofman, & Eberhardt, 1977)
Hutton Cliffs (77° 44' 00" S 166° 51' 00" E)	*Leptochynotes weddellii (Weddell)*	1977	(Siniff et al., 1977)
Erebus Glacier Tongue (77° 42' 00" S 166° 40' 00" E)	*Leptochynotes weddellii (Weddell)*	1977	(Siniff et al., 1977)
Tent Island (77° 41' 00" S 166° 23' 00" E)	*Leptochynotes weddellii (Weddell)*	1977	(Siniff et al., 1977)
Big Razorback island (77° 41' 00" S 166° 30' 00" E)	*Leptochynotes weddellii (Weddell)*	1977	(Siniff et al., 1977)

Little Razorback Island (77° 40' 00" S 166° 31' 00" E)	*Leptochynotes weddellii (Weddell)*	1977	(Siniff et al., 1977)
Turks Head (77° 40' 00" S 166° 46' 00" E)	*Leptochynotes weddellii (Weddell)*	1977	(Siniff et al., 1977)
Inaccessible Island (77° 39' 00" S 166° 21' 00" E)	*Leptochynotes weddellii (Weddell)*	1977	(Siniff et al., 1977)
Cape Evans (77° 38' 00" S 166° 24' 00" E)	*Leptochynotes weddellii (Weddell)*	1998	(J. M. Burns, Trumble, Castellini, & Testa, 1998)
Cape Royds (77° 35' 00" S 166° 10' 00" E)	*Leptochynotes weddellii (Weddell)*	2009	(David G. Ainley & Siniff, 2009)
Cape Crozier (77° 31' 00" S 169° 24' 00" E)	*Hydruga leptonyx (Leopard)*	1967	(Penney, 1967)
McMurdo Sound (77° 30' 00" S 165° 00' 00" E)	*Lobodon carcinophagus (Crabeater)*	2008	(Davis et al., 2008)
Marble Point (77° 26' 00" S 163° 50' 00" E)	*Leptochynotes weddellii (Weddell)*	2009	(David G. Ainley & Siniff, 2009)
Cape Hallet (72° 19' 00" S 170° 16' 00" E)	*Ommatophoca rossii (Ross)*	1985	(Watkins, 1985)
Robertson Bay (71° 25' 00" S 170° 00' 00" E)	*Ommatophoca rossii (Ross)*	1985	(Watkins, 1985)
White Island (66° 44' 00" S 048° 35' 00" E)	*Leptochynotes weddellii (Weddell)*	2010 2014	(Banks, Cary, & Hogg, 2014; Gelatt et al., 2010)
Macquarie Island (54° 37' 00" S 158° 54' 00" E)	*Mirounga leonina (Southern Elephant)*	1991 1999 2000 2001 2002 2007 2008	(Charrassin et al., 2008; Engelhard, Hall, Brasseur, & Reijnders, 2002; Little, 1991; McMahon, Burton, & Bester, 1999; McMahon, Burton, & Bester, 2000; J. Van den Hoff, 2001; John van den Hoff, Burton, & Raymond, 2007; John van den Hoff, Burton, Hindell, Sumner, & McMahon, 2002; John Van Den Hoff & Morrice, 2008)
	Hydruga leptonyx (Leopard)	2008	(Davis et al., 2008)

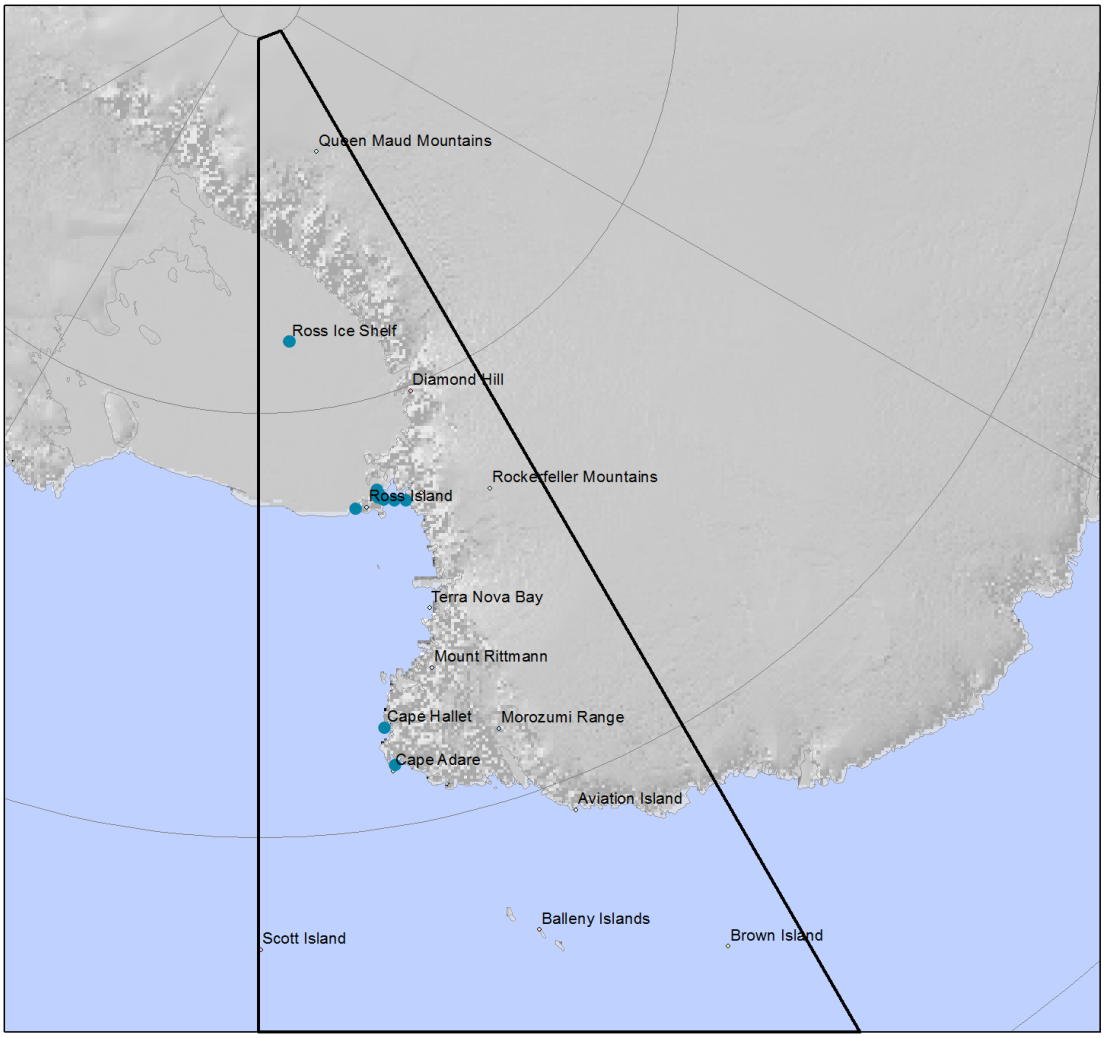

Figure 19. Map of seal colonies in the Ross Sea region

CONCLUSION

The Ross Sea region has a very unique assemblage of wildlife colonies, distributed throughout the region. They range from tiny algae and cyanobacteria in meltwater ponds in the McMurdo Dry Valleys to the thousands of penguins at Cape Adare. All of the organisms play important role in the Antarctic ecosystem and can be useful indicators of environmental change.

Future research could focus on areas other than Ross Island; most studies are concentrated in this area due to the proximity to Scott Base and McMurdo Station and this means that less is known about wildlife colonies in other areas, especially in the case of protozoa, rotifers and tardigrades. There is also a bias toward charismatic megafauna such as a penguins and seals which are intensively studied whilst smaller organisms that are equally, if not more, important are overlooked.

This report, together with the GIS map will provide a valuable resource for environmental impact assessment reports, informing field teams and tourism companies and raising awareness about enviromental issues and can be continually updated.

ACKNOWLEDGEMENTS

I would like to thank my supervisor Ceisha Poirot for her guidance, John Thyne for organising the GIS component and Daniela Liggett and the PCAS team for this amazing course. Data used in the GIS map was downloaded from SCAR's Antarctic Digital Database.

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